GREAT BARRIER REEF EXPEDITION
1928–29

VOLUME IV

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION
1928–29

SCIENTIFIC REPORTS

VOLUME IV

POLYCHAETA, OLIGOCHAETA, ECHIUROIDEA AND SIPUNCULOIDEA
ENTEROPNEUSTA
TUNICATA
AMPHIPODA
THE ALCYONARIAN FAMILY XENIIDAE, ETC.
HYDROIDA
ECHINODERMATA (OTHER THAN ASTEROIDEA)
ASTEROIDEA
FISHES
SIPHONOPHORA
STOMATOPOD LARVAE, CUMACEA AND CLADOCERA
THE POLYZOA, WITH A NOTE ON AN ASSOCIATED HYDROID
GORGONACEA
SPONGES
THE SILICOFLAGELLATA AND TINTINNOINEA

B. M. (N.H.)

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11, GRAFTON STREET, NEW BOND STREET, LONDON, W. 1; DULAU & CO., LTD., 29, DOVER STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W. 7

1931–1934

Made and printed in Great Britain.

Adlard & Son, Ltd., 21, Hart Street, W.C. 1.

CONTENTS

No.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 1

POLYCHAETA, OLIGOCHAETA, ECHIUROIDEA, AND SIPUNCULOIDEA

BY

C. C. A. MONRO, M.A.

Assistant Keeper in the Department of Zoology

WITH FIFTEEN TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, W. 1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W. 7
1931

Price Two Shillings and Sixpence.

[*Issued 28th February*, 1931]

Made and printed in Great Britain

POLYCHAETA, OLIGOCHAETA, ECHIUROIDEA, AND SIPUNCULOIDEA

BY

C. C. A. MONRO, M.A.,

Assistant Keeper in the Department of Zoology.

WITH FIFTEEN TEXT-FIGURES

CONTENTS

POLYCHAETA.

INTRODUCTION.

This report deals with benthic species only; the pelagic species collected by the Expedition will be described in a later publication. The specimens in this collection were obtained from various points on the Great Barrier Reef, the majority from Low Isles (lat. 16° 23′S.). Those collected in the course of the ecological survey of Low Isles and the neighbouring reefs have in the locality lists after the words " Gen. survey " and the date a place-name or a symbol referring to the key-chart given in Dr. Stephenson's report on the ecological survey. Dredged or trawled specimens have a station-number, and the

name of the boat in which they were obtained preceding their specifications of locality. A full account of the stations and the apparatus used is contained in Dr. C. M. Yonge's report on the conduct of the expedition.

LIST OF SPECIES:

Family AMPHINOMIDAE.
- *Eurythoe complanata* (Pallas).

Family APHRODITIDAE.
- *Pontogenia villosa*, Horst.

Family POLYNOIDAE.
- *Thormora johnstoni* (Kinberg).
- *Lepidonotus stephensoni*, n. sp.
- *Lepidasthenia terrae-reginae*, n. sp.
- *Gastrolepidia clavigera*, Schmarda.
- *Iphione muricata* (Savigny).

Family SIGALIONIDAE.
- *Sthenelais variabilis*, var. *glabra*, Potts.
- *Sthenelais malayana*, Horst.

Family POLYODONTIDAE.
- *Polyodontes melanonotus* (Grube).

Family PHYLLODOCIDAE.
- *Phyllodoce malmgreni*, Gravier.

Family HESIONIDAE.
- *Hesione intertexta*, Grube.
- *Hesione genetta*, Grube.
- *Hesione ? splendida*, Savigny.
- *Leocrates chinensis*, Kinberg.

Family SYLLIDAE.
- *Odontosyllis hyalina*, Grube.

Family NEREIDAE.
- *Nereis unifasciata*, Willey.
- *Perinereis nancaurica* (Ehlers).
- *Perinereis helleri*, Grube.
- *Perinereis camiguina*, Grube.
- *Perinereis nigropunctata*, Horst.
- *Perinereis obfuscata*, Grube.
- *Platynereis polyscalma*, Chamberlin.
- *Ceratonereis tentaculata*, Kinberg.

Family GLYCERIDAE.
- *Glycera gigantea*, Quatrefages.
- *Goniada tripartita*, n. sp.

Family EUNICIDAE.
- *Eunice antennata*, Savigny.
- *Eunice grubei*, Gravier.
- *Eunice aphroditois* (Pallas).
- *Eunice afra*, Peters.
- *Marphysa mossambica*, Peters.
- *Lysidice collaris*, Grube.
- *Onuphis*, sp.
- *Arabella longipedata*, n. sp.

Family SPIONIDAE.
- *Scolelepis indica*, Fauvel.

Family CHAETOPTERIDAE.
- *Mesochaetopterus minuta*, Potts.

Family OPHELIIDAE.
- *Armandia lanceolata*, Willey.

Family CAPITELLIDAE.
- *Dasybranchethus fauveli*, gen. et sp. nov.
- *Dasybranchus*, sp.

Family AMPHICTENIDAE.
- *Pectinaria (Pectinaria) brevispinis*, Grube.
- *Pectinaria (Pectinaria) antipoda*, Schmarda.

Family TEREBELLIDAE.
- *Loimia medusa* (Savigny).
- *Loimia montagui* (Grube).
- *Pista typha* (Grube).

Family SERPULIDAE.
- *Spirobranchus giganteus* (Pallas).
- *Salmacina dysteri* (Huxley).

There are 46 species, of which 5 are new ; one of the latter is the genotype of a new genus of Capitellids. *Pontogenia villosa*, Horst, is a curious form, very close to *Aphrodite.*

The heteronereid of *Perinereis obfuscata*, Grube, is new, and I have been able to add to the number of records of the aberrant heteronereid *Platynereis polyscalma*, Chamberlin, the atocous form of which is not known.

SYSTEMATIC ACCOUNT.

Family Amphinomidae.

Eurythoe complanata (Pallas).

Chamberlin, 1919, p. 28, for synonymy.

Occurrence.—Low Isles, Gen. survey; 6.xii.28, sand flat, "Under stones" (1).—28.iii.29, "Mangrove Park" (1).

4.iv.29, F. 6, "Dug up in sandbank near oyster-pen" (1).—11.iv.29, "Between anchorage reefs and Tripneustes Spit" (1).

Low Isles, "From rocks" (1); Low Isles (2); Batt Reef (3).

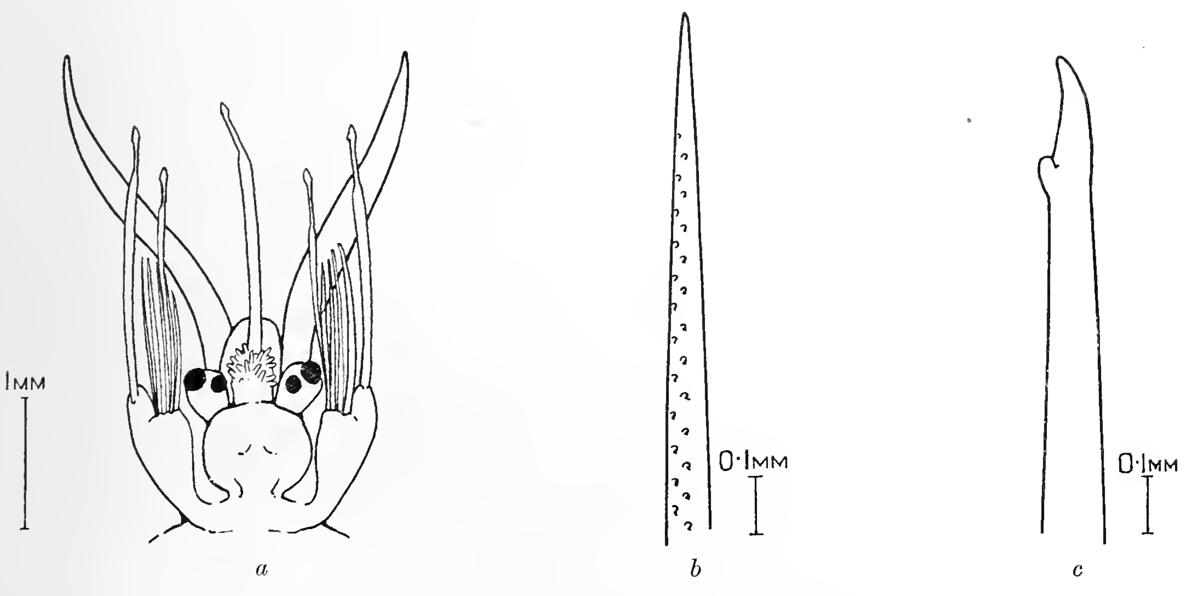
Family Aphroditidae.

Pontogenia villosa, Horst.

Horst, 1917, p. 139, figs. 1 and 2.

Occurrence.—Low Isles, "From rocks" (1).

Remarks.—The specimen measures 26 mm. by 10 mm. for 34 chaetigers. The thick dorsal felting gives it the appearance of an *Aphrodite*, from which it is distinguished



Text-fig. 1.—*Pontogenia villosa*. *a*, head; *b*, dorsal bristle; *c*, ventral bristle.

by the presence of eye-stalks and clearly bifid ventral bristles. The eye-stalks (Text-fig. 1*a*) are about half as long as the prostomium and each carries a pair of eyes at its tip; the dorsal member of each pair of eyes is rounded and the ventral oblong, and twice the size of the dorsal. The median tentaculophore is slightly longer than the eye-stalks and its tentacle is more than twice its length. The palps and the dorsal tentacular cirri are about the same length as the median tentacle; the ventral tentacular cirri are slightly shorter.

The dorsal cirri are completely concealed by the felting ; they are about the same length as the dorsal bristles and end in a clavate tip. The ventral cirri are very short, scarcely reaching to the bases of the ventral bristles.

The brown dorsal bristles (Text-fig. 1*b*) are directed fanwise upwards and backwards ; they are almost wholly hidden by the dorsal felting. They are very slightly curved, and on one edge are furnished with two rows of small alternating tubercles. The ventral bristles (Text-fig. 1*c*) are four in number and are more clearly bifid than those in Horst's type-specimen.

The dorsal felting consists of three kinds of bristles : (1) Very long slender yellow capillary bristles ; (2) colourless bristles, about half as stout as the preceding ; (3) minute microscopic hairs. I cannot see the articulated appearance attributed by Horst to the intermediate type of felting bristle.

I believe the only other record of this species is the original one from the Malay Archipelago.

Family Polynoidae.

Thormora johnstoni (Kinberg).

Monro, 1928b, p. 467.
Thormora jukesi, Baird, auctorum.

Occurrence.—Low Isles (1).

Remarks.—This specimen closely resembles those I described (*loc. cit.*) from Tahiti and the Marquesas.

Lepidonotus stephensoni, n. sp.

Occurrence.—Low Isles (1).

Description.—The example measures 30 mm. by 5 mm. without the feet for 25 chaetigers. The large flesh-coloured elytra with a dark spot over the scar of attachment give this specimen a very close resemblance to the *L. oculatus* of Baird. It has a typical *Lepidonotus* head, and the tentacles, palps, tentacular cirri and the ventral cirrus of the first chaetiger are all of about the same length—approximately three times as long as the head. The tentacles and cirri are claviform and have a small thread-like terminal appendage. The dorsal cirri extend beyond the tips of the bristles and the ventral just reach to the end of the foot.

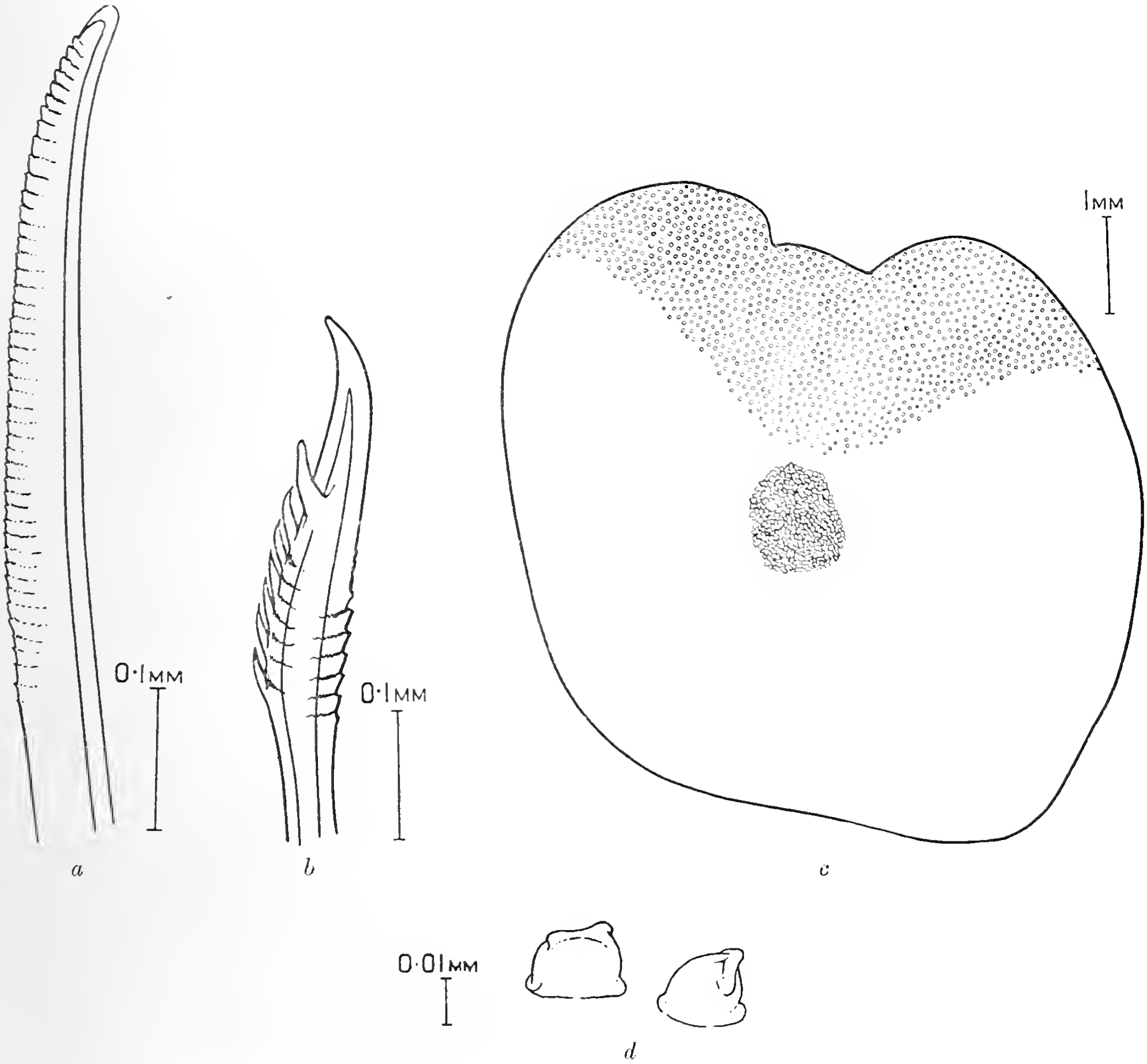
The structure of the bristles and feet is very similar to that of *L. oculatus*, of which Fauvel (1917, p. 171, pl. iv, figs. 20–23) gives a good account. The finely striated dorsal bristles (Text-fig. 2*a*) are fewer than in Baird's species, being only about four in number. They are very like the bristle of *L. oculatus* figured by Monro (1928a, p. 313). In the ventral bristles (Text-fig. 2*b*) the rows of spinules terminate distally in a large tooth ; but the apex is unidentate. So far this species is indistinguishable from *L. oculatus*.

It is, however, the structure of the elytra (Text-fig. 2*c*) that distinguishes this from Baird's species.

The characteristic mushroom-shaped tubercles of *L. oculatus* are absent.

The anterior border of the scale is slightly emarginate, and between it and the scar of attachment the scale is dotted with small semi-oval tubercles (Text-fig. 2*d*), similar to

those described and figured for *L. hedleyi* by Benham (1915, p. 181, pl. xxxviii, fig. 3) and by Pruvot (1930, p. 7, pl. i, fig. 9). The scales have no fringe and the pigment is confined to the scar of attachment, where, under the microscope, the granules have a reticular appearance.

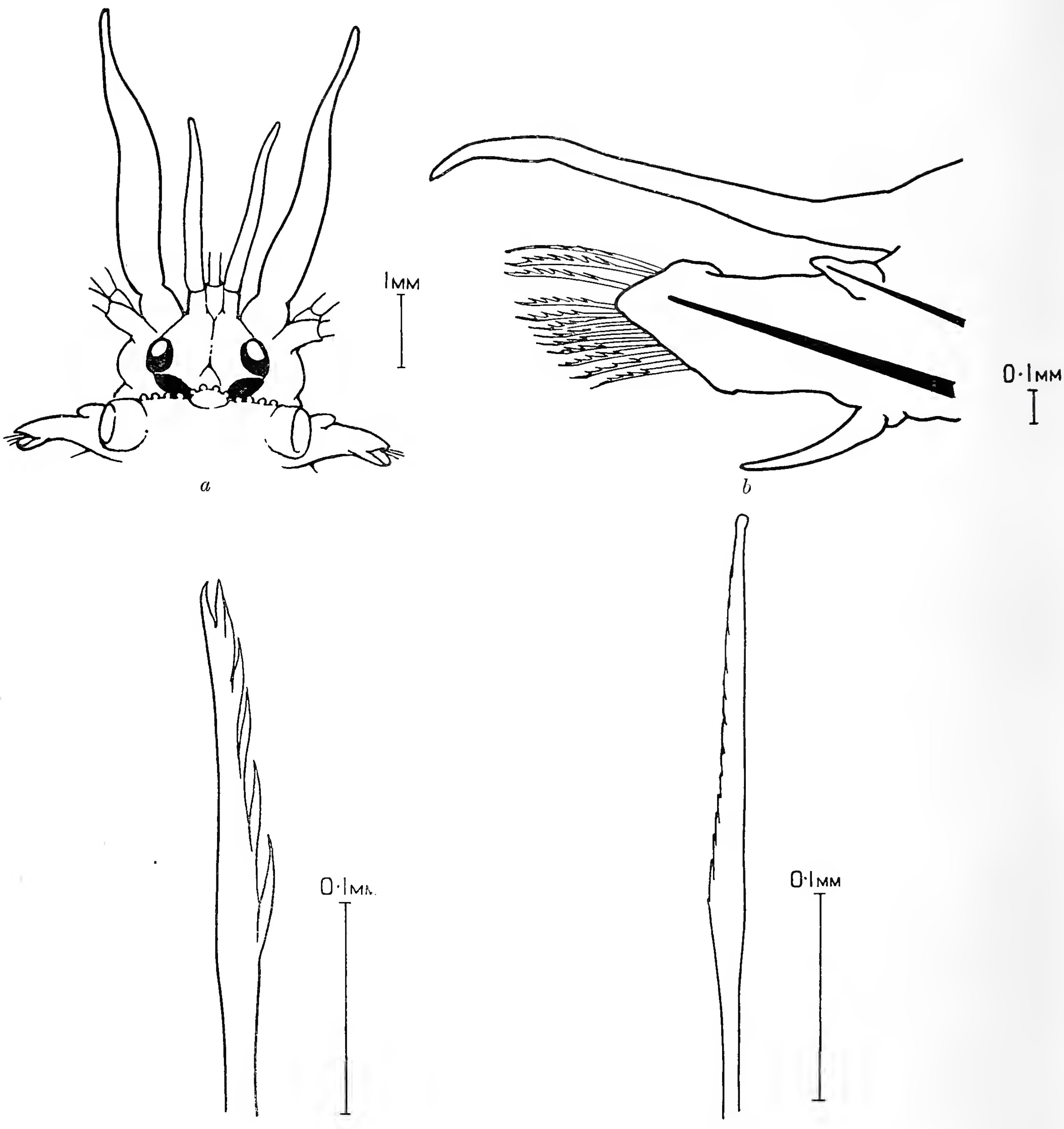


TEXT-FIG. 2.—*Lepidonotus stephensoni.* *a*, dorsal bristle ; *b*, ventral bristle ; *c*, scale ; *d*, tubercles on the scale.

REMARKS.—This form combines in a curious manner the characters of *L. oculatus* and *L. hedleyi*, resembling the former in everything except the elytral tubercles, which are like those of *L. hedleyi*. In the present state of our knowledge of the relations of Baird's and Benham's species I have no choice but to establish a new species. It belongs to the group of Lepidonotids with unfringed elytra and unidentate ventral bristles. *L. argus*, *L. australiensis*, *L. impatiens* and *L. javanicus* belong to the same group of species, but differ in the nature of the bristles and the tuberculation of the elytra.

Lepidasthenia terrae-reginae, n. sp.

OCCURRENCE.—Low Isles (2).



TEXT-FIG. 3.—*Lepidasthenia terrae-reginae.* *a*, head; *b*, anterior foot; *c*, normal bristle from 17th foot; *d*, dorsalmost bristle of 17th foot.

DESCRIPTION.—The body is long and vermiform, the larger specimen measuring 49 mm. by 2 mm. without the feet for 80 chaetigers. In spirit the colour is confined to two rows of brown spots, one on each side of the back above the feet; there is also a small

brown spot on every elytron just median to the scar of attachment. Both specimens are incomplete posteriorly. The head is bilobed and broader than long (Text-fig. 3*a*). There are two pairs of round, contiguous, laterally situated eyes. The palps are stout tapering structures, which, when laid along the back, reach to the 6th chaetiger. The median terminally inserted tentacle is lost, as are also the tentacular cirri. Behind the head is a crescentic nuchal flap or gibbosity, the margin of which carries four papillae ; and on each side of the nuchal organ there is a row of four papillae reaching to the bases of the first pair of elytrophores.

The arrangement of the elytra is as usual in the genus ; they are quite smooth, transparent and unfringed ; they are rather larger than in most of the species of the genus.

The dorsal cirri reach well beyond the tips of the bristles ; the ventral cirri arise halfway down the feet and are about one third of their length. The feet (Text-fig. 3*b*) are very long, being, without the bristles, equal in length to the breadth of the back. They are clearly biramous, the notopodium being represented by a distinct lobe, supported by an aciculum ; there are no notopodial bristles. The neuropodium carries about twenty bidentate bristles of the usual *Lepidasthenia* kind, with about seven rows of teeth (Text-fig. 3*c*). Of these bristles the more dorsal are slightly longer and more slender than the ventral and have the separation of the two terminal teeth more clearly marked. In addition, for about the first twenty chaetigers there is a pair of longer and more delicate bristles situated dorsally to the rest ; these dorsal bristles (Text-fig. 3*d*) have an undivided tip and are very faintly toothed throughout the greater part of their length. They disappear by the 30th chaetiger.

Remarks.—The presence of a papillated nuchal flap distinguishes this species from all the other members of the genus except *L. michaelseni*, Augener, from south-west Australia. It differs from that species in having a much smaller nuchal organ, a more prominent notopodium and no unidentate dorsal bristles behind the 30th chaetiger.

Gastrolepidia clavigera, Schmarda.

Pruvot, 1930, p. 13, pl. i, figs. 16–19, with synonymy.

Occurrence.—Low Isles ; Gen. survey ; 10.iv.29, A4 (1).

Low Isles (1), Batt Reef (1), " Locality unknown " (2).

Iphione muricata (Savigny).

Fauvel, 1930, p. 509.

Occurrence.—Low Isles, Gen. survey ; 19.xi.18, sand flat, " Under stones " (1).—22.iii.29, RD and R16 (1).—28.iii.29, G.3 (1).—4.iv.29, F.9 (1).—5.iv.29, I.M.4 and I.M.5 (1), " Between Madrepore Moat and Mangrove Park " (5).—" The Thalamita Flat " (1).

St. 14. " Magneta." 7.iii.29, $\frac{1}{2}$ mile S.E. Lizard Island, 19 fms. Bottom shell gravel ; rich *Halimeda* (1).

St. 17. " Magneta." 9.iii.29, about $\frac{1}{4}$ mile N. of N. Direction Island, 19 fms. Bottom sand ; thick *Halimeda* (1).

Low Isles (6).

Family SIGALIONIDAE.

Sthenelais variabilis, var. *glabra*, Potts.

Potts, 1910, p. 349, pl. xix, figs. 22–23, pl. xxi, fig. 63.
Sthenelais variabilis, Horst, 1917, p. 111, pl. xxii, fig. 6.

OCCURRENCE.—St. 5, "Merinda," 24.xi.28, Linden Bank, 37 fms.; bottom mud; Agassiz trawl (3).

REMARKS.—Three rather ill-preserved fragments, of which only one retains any scales. They correspond to Potts's account of the smooth variety of this species, except that the reduction of the tubercles on the elytra has gone a stage further, and all but the most anterior elytra are without tubercles; as in Potts's figure, the external border has a few large papillae. I can confirm Potts's observation that in several feet from the same specimen the simple upper neuropodial spinose bristles may be present, or they may be replaced by compound bristles with long, very slender jointed blades; in these the head of the shaft is usually denticulated. The most frequent condition is that both the simple spinose and the slender compound bristles are present in the upper part of the neuropodium.

There are three ctenidia. The number of stylodes appears to vary from one foot to another. In a number of feet I have seen a group of about 5 stylodes in the notopodium lying above the bristles, one or two in the middle of the neuropodium and two at the base of the feet.

Sthenelais malayana, Horst.

Horst, 1917, p. 114, pl. xxiii, figs. 7–9.

OCCURRENCE.—West of Low Isles, 15.xi.28, 8 fms; bottom mud (1).

REMARKS.—A single anterior fragment belonging to this species. The anterior end is infested with a small Polyzoan, probably the "? rotatoria" of Horst's account. The scales are thickly dotted with small semicircular tubercles and the external margin has a few long papillae; the number of papillae is considerably less than that in Horst's figure.

The slender compound neuropodial bristles lying just below the simple spinose neuropodial bristles have very long delicate terminal articles, and in these the bifid tips are often very difficult to see. In the more ventral upper neuropodial bristles the bifid tips are usually more clearly visible. The articulations of the appendix in the multi-articulate bristles are very much less distinct than in *S. variabilis*. Horst gives three as the number of ventral bristles with a single-jointed appendix; in this specimen there are at least six.

Family POLYODONTIDAE.

Polyodontes melanonotus (Grube).

Panthalis melanonotus, Grube, 1878, p. 48, pl. iv, fig. 1.
Panthalis melanonotus, Fauvel, 1919, p. 339, pl. xv, figs. 1–3, pl. xvii, figs. 70–75, with synonymy.

OCCURRENCE.—West side of Low Isles, 8 fms.; mixed bottom (1).

REMARKS.—A single anterior fragment of 33 chaetigers. Fauvel has given a full account of this species. The scales have a narrow black border interrupted where the edge is reflexed to form a pouch.

The first foot is not extended, as in Fauvel's figure, but much contracted; it resembles that figured by Horst (1917, pl. xxviii, fig. 7) for his *Polyodontes sibogae*, which Fauvel

regards as identical with Grube's species. The feet are rugose and I cannot with certainty distinguish any branchial papillae. In the allied *P. mortenseni*, Monro, the elytra are not areolated as they are in the present species.

Family PHYLLODOCIDAE.

Phyllodoce malmgreni, Gravier.

Gravier, 1900, p. 207, pl. x, figs. 29–31, text-figs. 66–69.
Fauvel, 1919, p. 360.

OCCURRENCE.—Low Isles, Gen. survey ; 20.iv.29, " The Sand Flat " (1).

REMARKS.—A very long, slender, much-coiled specimen about 2 mm. in breadth. The dorsal median stripe is continuous for about the first 50 chaetigers, and then interrupted by segmental ridges joining the feet across the body : there are no intersegmental interruptions. I can see no nuchal papilla. The pharynx is not everted ; the oral region is covered with small papillae ; the aboral region has six longitudinal ridges, each divided into eight or nine large wart-like papillae. I have not dissected the third tentacular segment, but under a binocular I can see no chaetae.

The dorsal cirri in the middle feet are subrectangular.

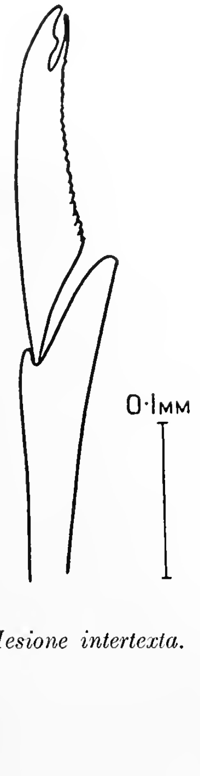
This is the first record of this species from Australian waters. Gravier records it from the Red Sea, Fauvel from Madagascar, and Augener from New Pomerania.

Family HESIONIDAE.

Hesione intertexta, Grube.

Monro, 1926, p. 311.

OCCURRENCE.—Low Isles ; 20.xi.28 (1).



TEXT-FIG. 4.—*Hesione intertexta*. Bristle.

St. 14. "Magneta." 7.iii.29; $\frac{1}{2}$ mile S.E. Lizard Island, 19 fms.; bottom shell gravel; rich *Halimeda* (2).

St. 17. "Magneta." 9.iii.29; about $\frac{1}{4}$ mile N. of N. Direction Island, 19 fms.; bottom sand; thick *Halimeda* (2).

Low Isles (4).

REMARKS.—This species has brown stripey markings, and in the bristles the accessory tooth of the chaetal guard approaches the apical tooth (Text-fig. 4*a*).

Fauvel does not attach any differential importance to differences in colour in *Hesione*, and regards the relation of the chaetal guard to the apical teeth as being too subject to changes due to age and wear to be of any value as a specific character. He suggests that most of the species of *Hesione* described from the Indo-Pacific belong to the European *H. pantherina* Risso, which is probably the same as the imperfectly characterized *H. splendida* Savigny.

Having examined the present material, I see no reason to alter my opinion that when all allowances have been made for changes due to wear, etc., the relation of the chaetal guard to the apical teeth is of value as a specific differential. However, in the example attributed by me to *H. splendida* because of its lack of definite colour markings (*v.* Pruvot, 1930, p. 29), the absence of the chaetal guard would seem to substantiate Fauvel's view, if, as I have assumed, this absence is due to wear.

Between the examples of *H. intertexta* and *H. genetta* there is a definite difference in the length of the accessory tooth of the chaetal guard, associated with extreme differences in colour-pattern.

Hesione genetta Grube.

Horst, 1924, p. 193.

OCCURRENCE.—Low Isles (3).

TEXT-FIG. 5.—*Hesione genetta.* Bristle.

REMARKS.—This species has the back covered with purple spots, and a transverse band of white between the 2nd and 3rd chaetigers. In the bristles the accessory tooth of the guard approaches the subapical tooth (Text-fig. 5*a*).

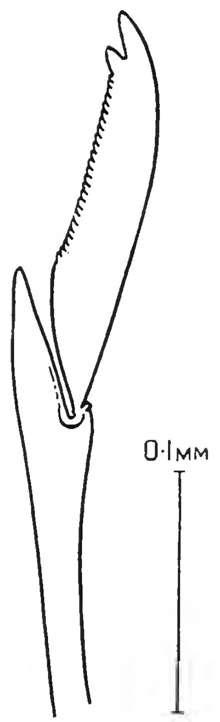
Hesione ? splendida, Savigny.

Pruvot, 1930, p. 27.

Occurrence.—Jukes Reef (1).

Description.—A single well-preserved specimen measuring 54 mm. by 5 mm. for 16 chaetigers is referred, with some doubt, to this species.

The specimen is flesh-coloured in spirit, and in each segment there is a square dorsal mark paler in colour than the rest of the body. On each side of the body just above the feet there is a series of thickened, probably glandular pads. Anteriorly the shape of the head is difficult to interpret owing to the distortion caused by the partial extrusion of the pharynx. It is roughly cordiform, and I can see no anterior indentation of the



Text-fig. 6.—*Hesione splendida.* Bristle.

prostomium. There is no trace of palps, and the usual pair of very small tentacles is present. There are two pairs of lateral eyes, of which the anterior is the larger. There are eight pairs of long tentacular cirri, the longest reaching back to the middle of the 2nd chaetiger.

Except for the one or two small bristles within the bases of the dorsal cirri the parapodia are uniramous. The dorsal cirri are very long and indistinctly annulated; when laid across the back they reach beyond the mid-dorsal line. The ventral cirri are more distinctly annulated and reach to the tips of the bristles. The terminal segment is achaetous and its pedal lobes lying up against the anus send out two pairs of anal tentacular cirri. There is also a pair of long anal cirri in the median line.

The feet are cylindrical and supported by a single black aciculum; they end in a pair of vertical lips from which there issue dorsally two finger-shaped retractile processes, and below these the neuropodial bristles.

These bristles are compound bidentate chaetae of the usual Hesionid kind except that after a prolonged and careful search I cannot find any trace of a chaetal guard on the blades (Text-fig. 6*a*).

It is impossible to decide whether the absence of the guard is due to wear, etc., or whether it is a natural feature. If it be natural, a new species should be established for this specimen; the present material is, however, insufficient to warrant the assumption that there is a species of *Hesione* without chaetal guards. Except for the absence of the latter, the specimen agrees well with the example from New Caledonia attributed to Savigny's species by Pruvot.

Leocrates chinensis, Kinberg.

Horst, 1924, p. 193.

Leocrates anonymus, Hessle, 1925, p. 15, fig. 4.

Occurrence.—St. 17. "Magneta." 9.iii.29; about $\frac{1}{4}$ mile N. of N. Direction Island, 19 fms. Bottom sand. Thick *Halimeda*. Dredge (1).

Remarks.—This species is easily recognizable by its large facial tubercle.

Family Syllidae.

Odontosyllis hyalina, Grube.

Grube, 1878, p. 129, pl. vii, fig. 1.
Augener, 1913, p. 238.

Occurrence.—Low Isles; 3.x.28. "Caught in lagoon after dark. Phosphorescent" (2).

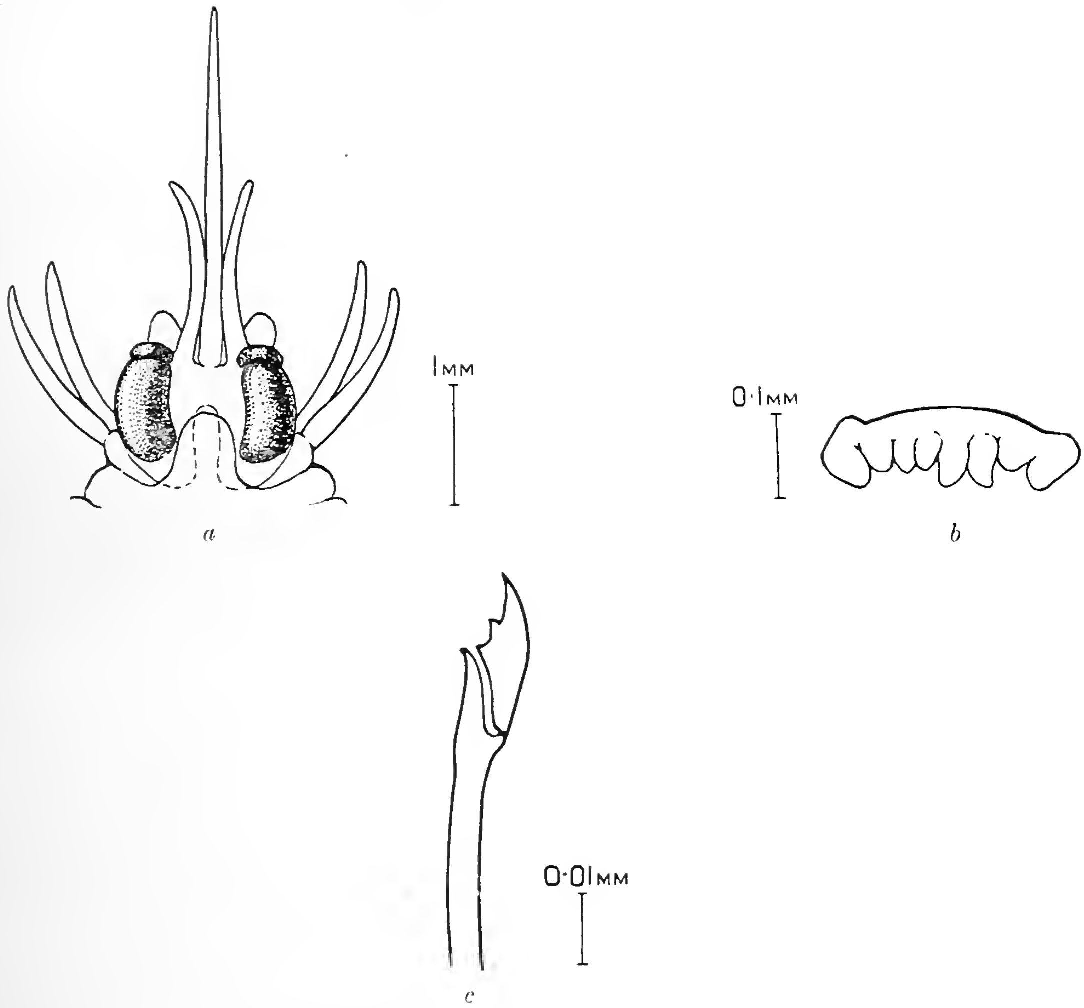
Remarks.—Two specimens broken into a number of fragments. The breadth is 2 mm. including the feet. They are colourless except for the eyes and in an epitocous condition. There is no trace of stolonization.

The head (Text-fig. 7*a*) is divided behind by a deep groove, to the front end of which the occipital gibbosity reaches. There are two pairs of enormous brown eyes, fused into a single mass. The anterior pair is directed forwards and the posterior upwards.

The palps are fused at their base and rather prominent. The lateral tentacles are slightly longer than the head, and the median tentacle is twice as long as the laterals. The dorsal cirri are slender cylindrical structures, alternately longer and shorter; they reach well beyond the tips of the bristles. The ventral cirri are short conical organs reaching to the end of the pedal lobe.

The pharynx reaches to the 7th chaetiger and the proventriculus to the 17th. The pharynx is armed with eight teeth (Text-fig. 7*b*), two large lateral teeth and six smaller teeth between them. The bristles have very short bidentate blades, with the subapical tooth occurring about halfway down the blade (Text-fig. 7*c*). The swimming-bristles begin on the 34th chaetiger. I can see no trace of the pigmentation of the nephridia described by Grube. Augener has supplemented and modified Grube's original account of this species, but has added no figures.

Grube mentions the fact that it is phosphorescent.



TEXT-FIG. 7.—*Odontosyllis hyalina*. *a*, head ; *b*, teeth ; *c*, compound bristle.

Family NEREIDAE.

Nereis unifasciata, Willey.

Horst, 1924, p. 153, pl. xxxi, figs. 3 and 4, with synonymy.

OCCURRENCE.—Low Isles ; Gen. survey ; 28.iii.29. " Mangrove Park " (1).

REMARKS.—A single specimen doubtfully attributable to this species. It is incomplete, and measures 11 mm. by 2 mm. without the feet for 20 chaetigers, the last three of which are destroyed, so that, although the specimen is a ripe female, I cannot tell whether there is an epigamous change at the 19th chaetiger such as is recorded by Horst for his specimens. The specimen is colourless except for the three dark glandular marks on the ligules of the feet. The proboscis is not everted, but the arrangement of the paragnaths agrees with that given by Horst and other authors. I find that the ventral lobe of the foot extends about as far as the lower notopodial ligule and is longer than the ventral ligule. Willey

figures the ventral ligule longer than the ventral lobe and Horst describes them as of about the same length. The heterogomph spinigers of the lower ventral bundle are not fully heterogomph.

Perinereis nancaurica (Ehlers).

Nereis vancaurica, Ehlers, 1864–68, p. xx (Vorrede).
Grube, 1878, p. 83.
Nereis languida, Grube, 1867, p. 15, pl. ii, fig. 1, *a–b*.
Non *Nereis languida*, Kinberg, 1865, p. 169.
Nereis (*Perinereis*) *nancaurica*, Ehlers, Augener, 1922, p. 23.

Occurrence.—Low Isles ; 7.iii.29 (1).

Remarks.—The specimen measures 53 mm. by 3 mm. without the feet for 115 chaetigers. The species is distinguished by the presence of paired linear paragnaths in Group VI, and of very numerous, minute paragnaths on the maxillary ring. The maxillae have no secondary teeth. The proboscis is not everted, and I cannot give a detailed account of the number and arrangement of the paragnaths. The feet agree with Grube's figure. The arrangement of the bristles is as follows :

Notopodium : Homogomph spinigers.
Neuropodium : *Upper bundle :* Homogomph spinigers and heterogomph falcigers.
Lower bundle : Heterogomph spinigers and heterogomph falcigers.

There seems to be some confusion as to the origin and spelling of the specific name of this species. Grube (*loc. cit.*, 1878) refers it to p. 503 of Ehlers's ' Borstenwürmer ' : this is a mistake, as there is no mention of the name on that page. Actually the name is first used by Ehlers on p. xx of the *Vorrede* of his ' Borstenwürmer,' in which he points out that the name *languida* used by Grube for his species in 1867 is preoccupied by the *Nereis languida* of Kinberg 1865, Kinberg's species being distinct from that of Grube. Ehlers substitutes the name *vancaurica* for the *languida* of Grube, *Vancauri* being the locality given by Grube (1867) for his type-specimens. Presumably Vancauri is a printer's error for Nangkauri or Nancauri, an island in the Nicobar Group, where the Novara made extensive collections. This is held by Augener, for he changes Ehlers's specific name from *vancaurica* to *nancaurica*. I have adopted Augener's emendation.

Perinereis helleri, Grube.

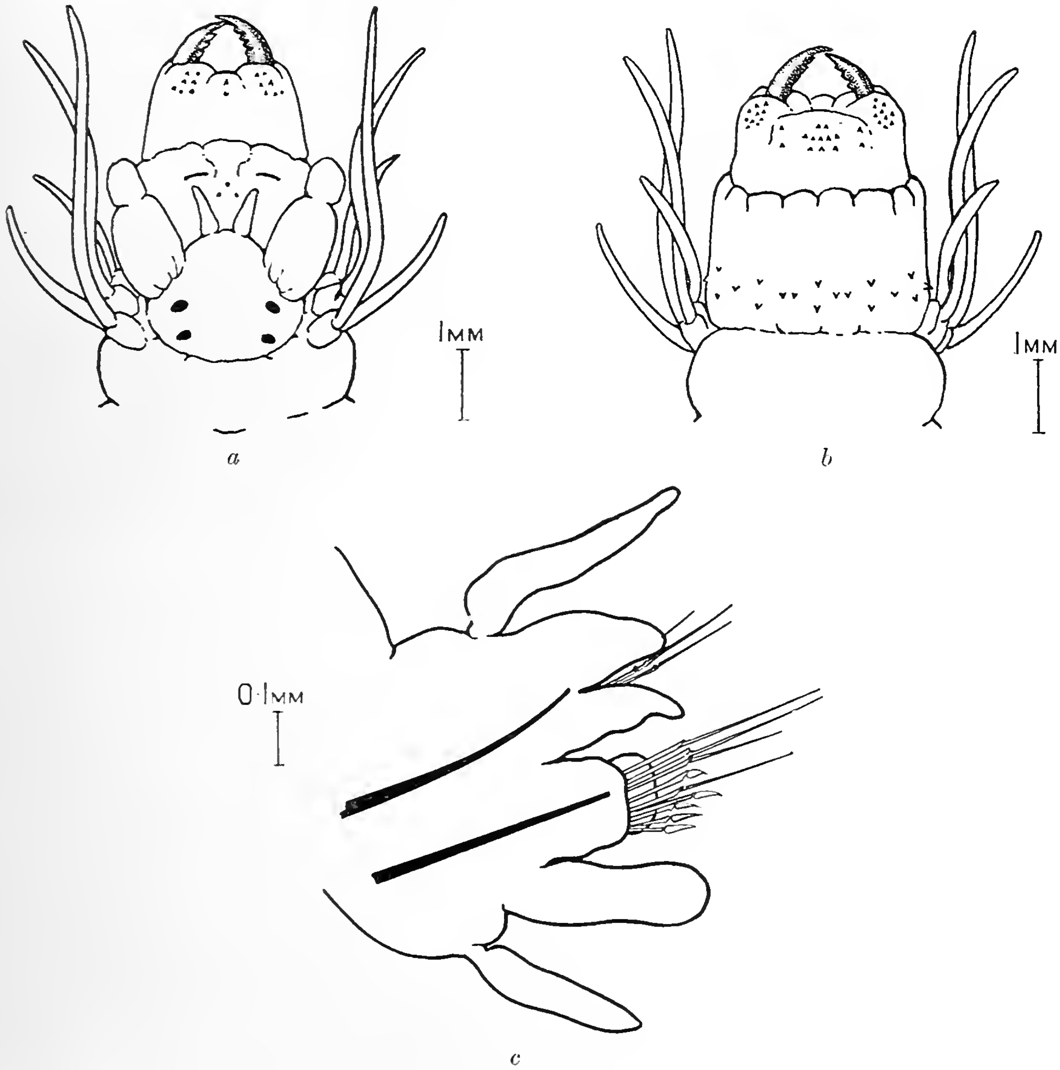
Grube, 1878, p. 81.
Horst, 1924, p. 172, pl. xxxiv, figs. 3, 4.

Occurrence.—Low Isles (2).

Remarks.—The larger specimen measures 66 mm. by 3 mm. without the feet. It has the proboscis (Text-fig. 8*a* and *b*) everted, and the arrangement of the paragnaths agrees in detail with Horst's account. Horst figures the foot.

Anteriorly the dorsal cirri (Text-fig. 8*c*) are longer than the dorsal lappet and posteriorly they are relatively longer still. The two dorsal lappets are larger relatively to the ventral ramus in the posterior region than they are in the anterior, but the upper dorsal lappet is not enlarged in the hinder region of the body in a manner comparable with that, for example, in *P. nigropunctata*. The distinctive features of this species are the separation of the paragnaths in Group III into three groups and the presence of long dorsal cirri. *P. camiguina* has a similar arrangement of paragnaths, but short dorsal cirri.

I have elsewhere (1926, p. 315) treated this species as a local variety of *P. cultrifera*, and Fauvel (1930, p. 528) regards it as a synonym of the latter species. I am now inclined to think that both *P. helleri* and *P. camiguina* are distinct species, distinguished from *P. cultrifera* by the separation of the paragnaths in Group III into three distinct groups.



Text-fig. 8.—*Perinereis helleri.* *a*, head and proboscis from above ; *b*, head and proboscis from below ; *c*, middle foot.

P. helleri and *P. camiguina* are set apart by the great difference in the length of the dorsal cirri.

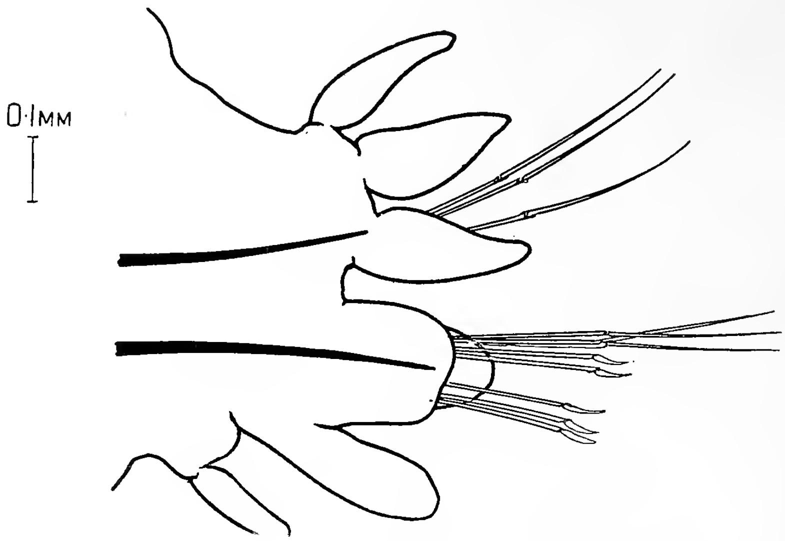
Perinereis camiguina, Grube.

Grube, 1878, p. 87, pl. iv, fig. 8.
Horst, 1924, p. 171, pl. xxxiii, fig. 7.

Occurrence.—Low Isles ; " From rocks " (1).

Remarks.—A single ill-preserved specimen measuring 46 mm. by 2 mm. without the feet. The proboscis is retracted. The arrangement of the paragnaths is similar to that in *P. helleri*. The dorsal cirrus (Text-fig. 9*a*) is slightly shorter than the dorsal lappet

and shows no relative increase in length in the hinder segments. There is no substantial enlargement of the upper dorsal lappet in the posterior region.



TEXT-FIG. 9.—*Perinereis camiguina.* Middle foot.

The *P. camiguina* of Augener (1922, p. 21) is described as having the dorsal cirri longer than the dorsal lappet and should therefore perhaps be referred to *P. helleri.* The present species seems to be distinguished from *P. helleri* only by the possession of much shorter dorsal cirri.

Perinereis nigropunctata, Horst.

Horst, 1924, p. 171.

Perinereis yorkensis, Augener, 1922, p. 24, text-fig. 6 *a–e*.

OCCURRENCE.—Low Isles ; Gen. survey ; 4.iv.29 ; F.9 (1).

REMARKS.—A single specimen measuring 21 mm. by 1 mm. without the feet. It has three rows of black spots as described by Horst. The proboscis is retracted, but as far as can be seen the arrangement of the paragnaths corresponds to Augener's figures. The lappets of the feet are less massive than as figured by Augener, but the general proportions are similar, and I find a similar enlargement of the dorsal lappet in the posterior region.

Perinereis obfuscata, Grube.

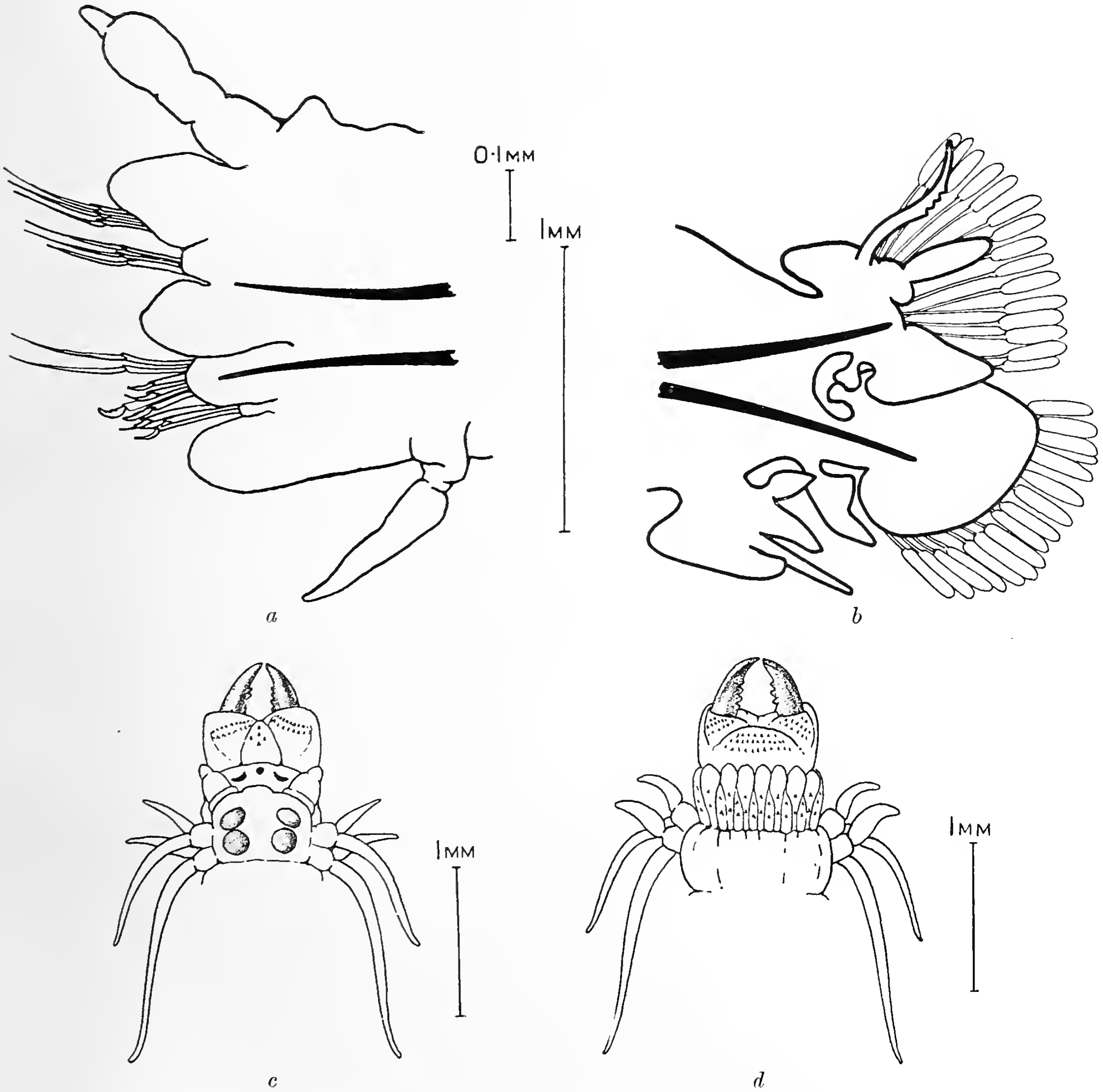
Horst, 1924, p. 173, pl. xxxiv, figs. 5, 6.

OCCURRENCE.—Low Isles ; " Worms collected round light " ; 8.ix.28 ; 2 epitocous males and 2 epitocous females, 3.x.28 ; " Worms caught in lagoon after dark, phosphorescent," one epitocous female. Gen. survey ; 1 atocous specimen.

REMARKS.—The atocous example is an anterior fragment, in which all the colouring is lost except some brown markings on the head. The proboscis is retracted, but as far

as can be seen the arrangement of the paragnaths is typical except that there are 6 paragnaths in Group I instead of the usual 5. The feet agree with Horst's figure.

The epitocous examples show interesting modifications. They measure between 12 and 15 mm. by 1 mm. without the feet. In the females the change to the epitocous



TEXT-FIG. 10.—*Perinereis obfuscata.* *a*, 5th foot of epitocous male ; *b*, modified foot of epitocous male ; *c*, head and proboscis of heteronereid from above ; *d*, head and proboscis of heteronereid from below.

condition begins at the 18th chaetiger, in the males at the 14th, in the females the thickening of the dorsal cirrus anteriorly extends over the first 5 chaetigers, in the males over the first 7 chaetigers, and in the males (Text-fig. 10*a*) it is more pronounced than in the females. Moreover, in the males only, the dorsal cirri of the sexually modified feet are crenellated on the under-surface (Text-fig. 10*b*).

One of the examples has the proboscis everted (Text-fig. 10*c* and *d*), and in this the paragnaths are arranged as follows :

I. A cruciform group of 5.
II. An oblique tristichous group of about 25.
III. A transverse group of about 25.
IV. An oblique mass of about 20.
V. One large paragnath.
VI. A single linear paragnath.
VII and VIII. A double row.

In the epitocous examples the eyes are greatly enlarged.

Fauvel (1930, p. 528) regards this species as a simple variety of *P. cultrifera.* They are indeed closely related, but that they are probably distinct is suggested by the fact that in the two species the modified heteronereid feet begin at different positions in the body. In *P. cultrifera,* in both male and female heteronereids, the epitocous feet begin from the 19th to 20th chaetigers. *P. striolata* Grube appears to differ only in the fact that the tentacular cirri reach to the 9th chaetiger, while Grube gives the 3rd chaetiger for the distance reached by the tentacular cirri of *P. obfuscata.*

In the present specimens, as in Horst's, the tentacular cirri reach to the 5th–6th chaetiger.

Platynereis polyscalma, Chamberlin.

Chamberlin, 1919, p. 219, pl. xxx, figs. 5–8 ; pl. xxxi, figs. 1–10 ; pl. xxxii, figs. 1–2.
Horst, 1924, p. 186.
Nereis (Platynereis) integer, Treadwell, 1920, p. 595, figs. 1–4.

Occurrence.—Low Isles ; " Worms collected round light, 8.ix.28 " (2).

Remarks.—Of these two specimens, one is an epitocous female measuring 23 mm. by 2 mm. without the feet and the other an epitocous male measuring 16 mm. by 1 mm. without the feet. The material does not allow me to add anything to the descriptions of this curious form by Gravier, Horst and Chamberlin.

Ceratonereis tentaculata, Kinberg.

Horst, 1924, p. 180, pl. xxxv, figs. 4–7, with synonymy.

Occurrence.—St. 12. " Magneta." 24.ii.29 ; Great Barrier Reef, Penguin Channel, 10–15½ fms., rock and shell gravel, mud on edges of pit (1).

Family Glyceridae.

Glycera gigantea, Quatrefages.

Fauvel, 1923, p. 387, fig. 152 *d–k.*

Occurrence.—Low Isles (1).

Remarks.—A single specimen without the proboscis. It is very long and slender, measuring 390 mm. by 3 mm. at its widest part without the feet. Owing to the absence of the proboscis I cannot determine this species with certainty, but the general facies, the feet with their two equal, bluntly pointed, anterior lips and the two short subequal

posterior lips and the vesicular retractile gill are indistinguishable from those of the European species. Augener (1927, p. 138) records this species from New Pomerania.

Goniada tripartita, n. sp.

Occurrence.—W. of Low Isles; about 8 fms., mud; (1).

Description.—A single fragment, incomplete posteriorly and measuring 38 mm. by 2 mm. including the feet for 118 chaetigers. For the first 80 chaetigers the body is cylindrical with a pad or cushion above every foot. Behind the 80th chaetiger the body is thicker, more flattened ventrally and dorsally arched. There is a conical prostomium with 10 rings and 4 small tentacles. The long proboscis is only partly everted, and dissection shows 2 large simple jaws with 3 teeth joined by a complete circle of about 24 X-shaped paragnaths alternately larger and smaller. There are at the base of the proboscis 8 chevrons on each side.

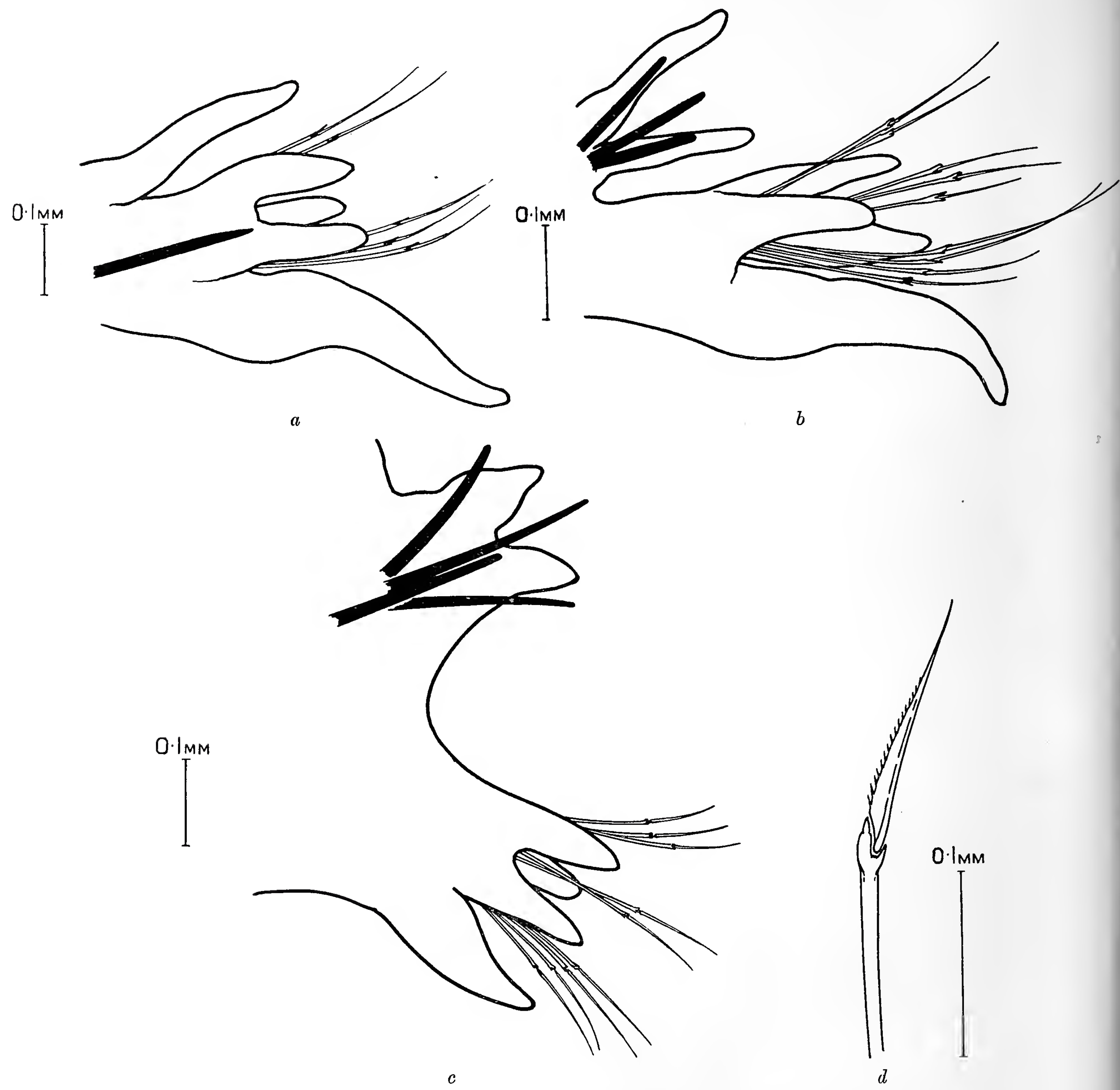
The first 51 segments have uniramous feet; from the 52nd to the 80th the feet are biramous, but the two branches are not separated, and the final change involving the separation of the notopod from neuropod and the disappearance of the pads above the feet does not take place before the 80th chaetiger.

The first foot is much reduced. The anterior feet (Text-fig. 11*a*) consist of a dorsal cirrus, a chaetal lobe with 3 pointed lips, of which two are anterior and lie in front of the bristles and the third is shorter and lies behind the bristles, and a massive ventral cirrus. For about the first 5 chaetigers the ventral cirrus is about the same length as the prechaetal lips; it rapidly increases in size, till by about the 20th chaetiger it is almost twice as long as the prechaetal lips and as broad as the chaetal lobe. The slender dorsal cirrus reaches to the end of the short post-chaetal lip. At the 52nd chaetiger a slender cirriform notopodial prechaetal process appears just below the dorsal cirrus, and with it an aciculum and 3 acicular chaetae, arranged fanwise (Text-fig. 11*b*). In the middle portion of the body, between the 52nd and 80th chaetigers, the ventral cirrus is relatively slightly shorter and the chaetal lips slightly longer than in the anterior region. In the middle region the dorsal cirrus becomes gradually thicker and more foliaceous from before backwards, as also to a much lesser extent does the notopodial prechaetal lip.

At the 81st chaetiger, where the posterior region begins (Text-fig. 11*c*), the dorsal cirrus and notopodial prechaetal lip become two small triangular lobes of about equal size, and in addition to the notopodial aciculum there are 3 acicular notopodial bristles. The neuropod has the pedal lips rather shorter and stouter than in the more anterior regions, and the ventral cirrus is more triangular and foliaceous; it reaches as far as the ends of the prechaetal lips. The neuropod has throughout an aciculum and a fan-shaped bundle of compound bristles with an articulation similar to that in the bristles of *G. eremita*; the blades are long, delicate and finely hirsute on one edge. The ventralmost chaeta (Text-fig. 11*d*) in every foot has a much shorter and more knife-shaped blade. This condition persists throughout the body.

Remarks.—*G. tripartita* belongs to that group of species which includes *G. emerita*, Audouin and M.-Edwards, *G. australiensis*, Quatrefages, *G. antipoda*, Augener, and *G. japonica*, Izuka; these are all characterized by the presence of acicular chaetae in the notopod. The present species is distinguished by the possession of three regions of the body—an anterior uniramous region, a middle biramous region in which notopod and

neuropod remain unseparated, and a third, posterior region where the change in the shape of the body and the separation of the notopod from the neuropod occur. Fauvel has



TEXT-FIG. 11.—*Goniada tripartita.* *a,* anterior foot from in front; *b,* foot of middle region from behind; *c,* foot of posterior region from in front; *d,* ventralmost bristle of first foot.

established a subgenus *Goniadopsis* for a form with 3 regions of the body, but his species has the feet of the first two regions uniramous, and is without chevrons on the proboscis.

Family Eunicidae.

Subfamily *Eunicinae*, Kinberg.

Eunice antennata, Savigny.

Fauvel, 1917, p. 225, with synonymy.

Occurrence.—Batt Reef (1). Low Isles (2).

St. 10. "Magneta." 22.ii.29; across Satellite Reef, working on sides to S.W. and N.E., 14–17 fms.; coral, shell gravel and mud (4).

St. 12. "Magneta." 24.ii.29; Penguin Channel, 10–15½ fms.; rock and shell gravel, mud on edges of pit (7).

St. 16. "Magneta." 9.iii.29; about ½ mile W. of N. Direction Island; 20 fms.; stony (3).

St. 17. "Magneta." 9.iii.29; about ¼ mile N. of N. Direction Island, 19 fms.; sand, thick *Halimeda* (3).

St. 19. "Magneta." 10.iii.29; about ½ mile N. of Eagle Island, 10 fms.; shell gravel, thick *Halimeda* (4).

St. 21. "Magneta." 11.iii.29; ½ mile N.W. Howick Islands, 10 fms.; mud and shell, forams (1).

St. 25. "Magneta." 17.iii.29; in Papuan Pass, 20–25 fms.; *Foraminifera* and coral fragments (2).

Eunice grubei, Gravier.

Gravier, 1900, p. 258, pl. xiv, figs. 87, 88, Text-figs. 125–129.
Pruvot, 1930, p. 68, with synonymy.

Occurrence.—Low Isles (2); Jukes Reef (1).

Eunice aphroditois (Pallas).

Fauvel, 1917, p. 215, pl. vii, with synonymy.

Occurrence.—Low Isles (1).

Eunice afra, Peters.

Fauvel, 1919, p. 374, with synonymy.

Occurrence.—Batt Reef (1); Low Isles; "Embedded in *Symphyllia*" (1).

Marphysa mossambica, Peters.

Fauvel, 1917, p. 232, fig. 22, with synonymy.

Occurrence.—Low Isles; Gen. survey; 18.iv.29; Mangrove Park (3).

Lysidice collaris, Grube.

Augener, 1913, p. 286, with synonymy.

Occurrence.—Low Isles; "From rocks" (1); Gen. survey; Boulder tract (2).

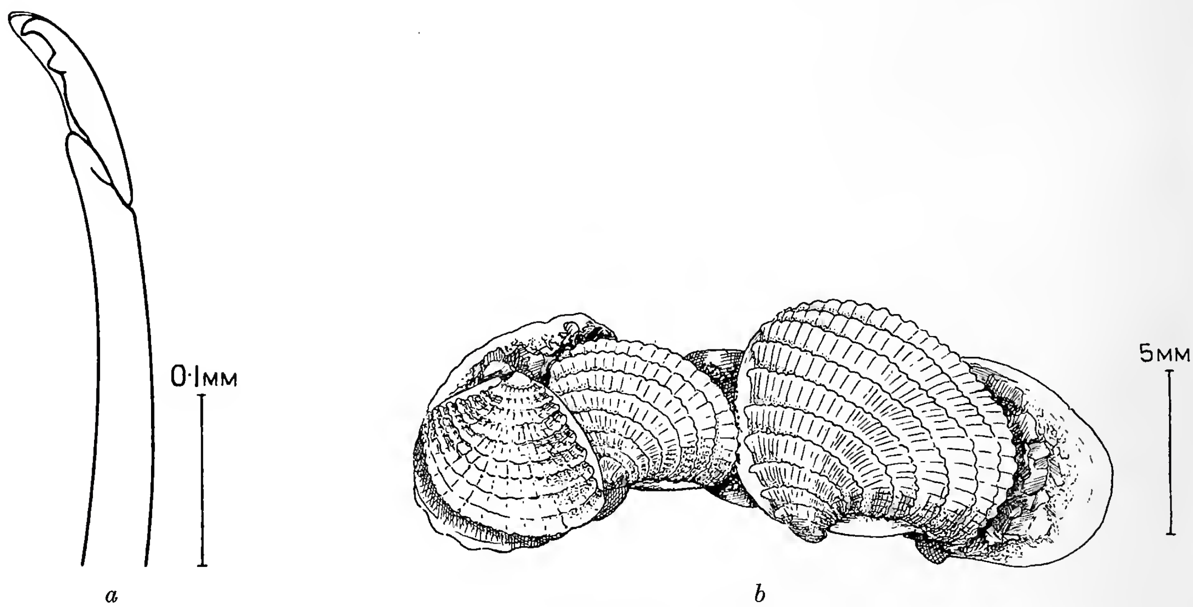
St. 10. "Magneta." 22.ii.29; across Satellite Reef, working on sides to S.W. and N.E., 14-17 fms.; bottom coral, shell gravel and mud. Dredge (1).

Subfamily *Onuphidinae*.

Onuphis, sp.

Occurrence.—Low Isles; Agassiz trawling off N. Anchorage; 9 fms.; low tide (1).

Description.—A single anterior fragment measuring 18 mm. by 2 mm. for 32 chaetigers. The head has a pair of eyes in front of the posterior lateral occipital tentacles. The ovoid palps and small frontal tentacles are of about the same length. Of the occipital tentacles the median is much the longest, reaching back to the 11th chaetiger; the anterior laterals are about a third of its length and the posterior laterals about two-thirds. The tentacular cirri reach to the bases of the palps.



Text-fig. 12.—*Onuphis*, sp. *a*, compound bristle from 1st foot; *b*, tube.

The first two chaetigers are longer than the rest and directed forwards, the ends of the first feet being on a level with the tips of the palps. They are not, however, markedly ventral in position as they appear to be in the genotype of Moore's *Paranorthia*.

The first feet consist of a slender dorsal cirrus, two rather elongated pedal lips, of which the posterior ends in a small cirriform process, and a stoutish ventral cirrus. The ventral cirrus becomes increasingly shorter and thicker from before backwards, until by the 6th foot it becomes a pad. The cirriform prolongation of the posterior lip of the foot also becomes gradually shorter, until by about the 16th foot it disappears. The gills begin as a small filament on the 9th chaetiger and remain unbranched throughout. At the 11th chaetiger the gill and the dorsal cirrus are of the same length; the gill rapidly increases in length, and the dorsal cirrus decreases so that at the 25th chaetiger the gill is about four times as long as the cirrus.

The first two chaetigers carry compound bidentate hooks (Text-fig. 12*a*); the normal bristles begin on the third chaetiger, and the 15th foot shows the usual bilimbate capillary bristles, comb bristles with the edges turned inwards as in *O. conchylega*, and a single bidentate acicular hook.

The animal was inhabiting a curious tube, consisting of a series of lamellibranch shells cemented together with their hinges at right angles to the long axis of the tube (Text-fig. 12*b*). The usual membranous cylinder forming the substructure of the tube seems to be absent.

REMARKS.—I cannot attribute this example to any species with certainty. It is close both to the northern *O. conchylega* and to McIntosh's *O. macrobranchiata* from Japan. In *O. conchylega* the anterior crochets are different, and the gills do not normally begin before the 11th chaetiger.

The arrangement of the gills in *O. macrobranchiata* is the same as in the present specimen, but McIntosh figures the anterior bidentate crochets as simple. Chamberlin has described an *O. lepta* from off Panama with unbranched gills beginning on the 6th chaetiger and continued to the 53rd. He does not, however, describe the tubes of this species, which were presumably of the normal type.

Subfamily *Lumbrinereinae.*

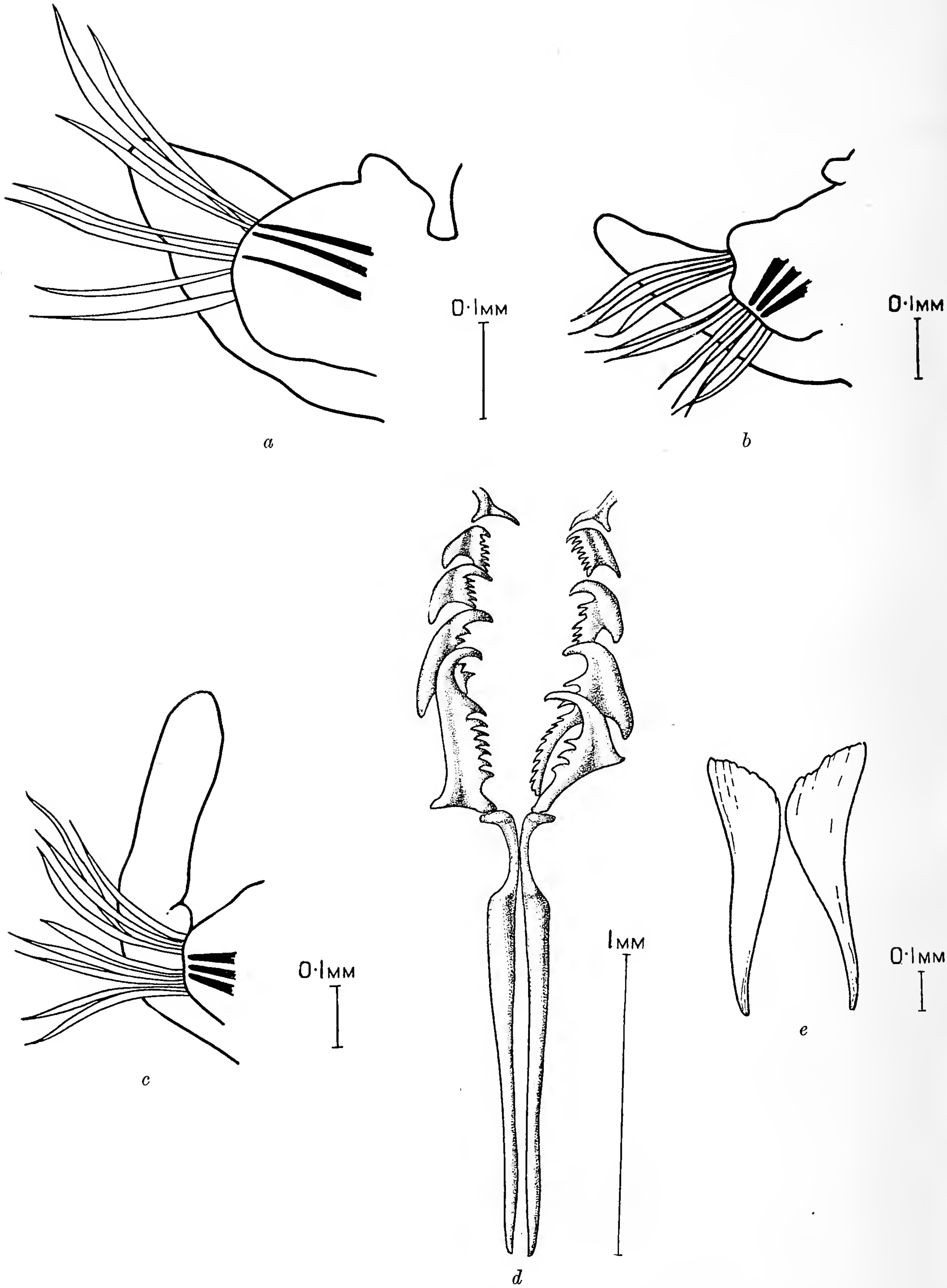
Arabella longipedata, n. sp.

OCCURRENCE.—"Merinda." St. 2 and 3. 24.xi.28: Great Barrier Reef, Linden Bank, 28 fms.; bottom sand and shell (1).

DESCRIPTION.—A single example, incomplete posteriorly. It measures 72 mm. by 2 mm. for 230 chaetigers. The body is cylindrical, and somewhat flattened ventrally. There are no colour markings. The prostomium is conical and I can see no eyes. The first two segments are achaetous and about equal in length. The second segment is not involved with the mouth.

The feet are of the usual shape, with a broad rounded anterior lip and a conical cirriform posterior lip. The feet are to some extent sunken in the body-wall, and it is very difficult to discover a dorsal cirrus. In the anterior (Text-fig. 13*a*) and middle segments (Text-fig. 13*b*) there is a small rounded button at the point where the foot merges dorsally into the body-wall, and this I take to represent the dorsal cirrus. This button is indistinguishable in the posterior segments. The posterior lip of the foot shows a gradual increase in size from before backwards, and whereas in the anterior segments it is a small process shorter than the bristles, in the posterior segments (Text-fig. 13*c*) it is a large cirriform structure, directed upwards and considerably longer than the bristles. The bristles are all simple, bordered and geniculate; their appearance varies widely according to the angle at which they are seen, but I have not been able to discover the usual denticulated wing at the base of the bordering. The feet are supported by three or four tapering acicula. I have seen no dorsal bristles, and there are no hooded acicular chaetae.

The upper jaws (Text-fig. 13*d*) have a pair of long slender black carriers, behind which is a short accessory support: M.I and M.II are asymmetrical, the long M.I of the left side has the teeth continued almost up to the terminal hook; the short M.I of the right side has a rather larger diastema between the terminal hook and the teeth. The number of teeth is as follows: M.I, 8 + 4; M.II, 6 + 12; M.III, 5 + 7; M.IV, 8 + 8; M.V, 1 + 1. The lower jaws (Text-fig. 13*e*) are black and their shape is as shown in the figure.



TEXT-FIG. 13.—*Arabella longipedata.* *a,* anterior foot; *b,* middle foot; *c,* posterior foot; *d,* upper jaws; *e,* lower jaws.

REMARKS.—I have established a new species for this specimen because I know no *Arabella* which shows a similar increase in length of the posterior lip of the foot. As far as the shape of the jaws goes, the present species is very like *A. novecrinita*, var. *asymmetrica*, Crossland (*v.* Crossland, 1924, fig. 104); but his species, equally with the *A. mutans* of Chamberlin, has hooded acicular bristles, absent from the present species. In the shape of its M.I it is intermediate between *A. iricolor* and its allies, with symmetrical pincers, and *A. geniculata*, in which the M.I have lost all resemblance to pincers and are toothed plates similar to M.II. *A. obscura* (Willey), from Ceylon (Willey, 1905, p. 285), has analogous upper jaw plates, but Willey's description was based on a small anterior fragment, and there is no reference to an increase in length posteriorly of the hinder lip of the foot. *A. moebiana* (Grube), from the Philippines, may possibly be identical with the present species, but Grube gives 4 teeth for M.V.

Family SPIONIDAE.

Scolelepis indica, Fauvel.

Fauvel, 1928, p. 4, fig. 2, *g–m*.

OCCURRENCE.—Low Isles; Gen. survey; 10.iv.29. The Sand Flat (1); and 20.iv.29 F.7 (2).

REMARKS.—Three specimens broken into a number of fragments. I have compared them with a co-type of Fauvel's species. Fauvel (*loc. cit.*) writes that the gill begins on the 2nd chaetiger. Actually the gill begins on the 1st chaetiger. Fauvel (*in litt.*) reports that the statement that the gill begins on the 2nd chaetiger is a printer's error, which he proposes to rectify in a subsequent publication.

Family CHAETOPTERIDAE.

Mesochaetopterus minuta, Potts.

Potts, 1914, p. 963, pls. ii and iii, figs. 7, 8.

OCCURRENCE.—Low Isles; Gen. survey; 20.iv.29. The Sand Flat, 2 specimens and a number of tubes.

REMARKS.—A cluster of horny tubes incrusted with sand-grains. The tubes may have a length of 20 cm., and the diameter is about 2 mm. Nearly all are empty, but I succeeded in extracting two macerated and incomplete specimens. The largest measures 52 mm. by 2 mm. at its widest part for about 36 chaetigers. As far as their condition permits examination, they seem to resemble Potts's description and figures, and in spite of the fact that they are twice as large as any examples recorded by Potts, I believe them to belong to Potts's species. The condition of the present specimens does not permit me to add anything to Potts's account. Potts mentions the occurrence of his species in the Torres Straits.

Family Opheliidae.

Armandia lanceolata, Willey.

Willey, 1905, p. 228, pl. v, fig. 120.
Fauvel, 1919, p. 435, with synonymy.

Occurrence.—Low Isles (1).

Remarks.—A single ill-preserved specimen. The anal funnel is destroyed. There are 29 chaetigers, gills from the 2nd to the 26th chaetigers, 3 cephalic eyes, and lateral eyes from the 7th to the 17th chaetigers.

Family Capitellidae.

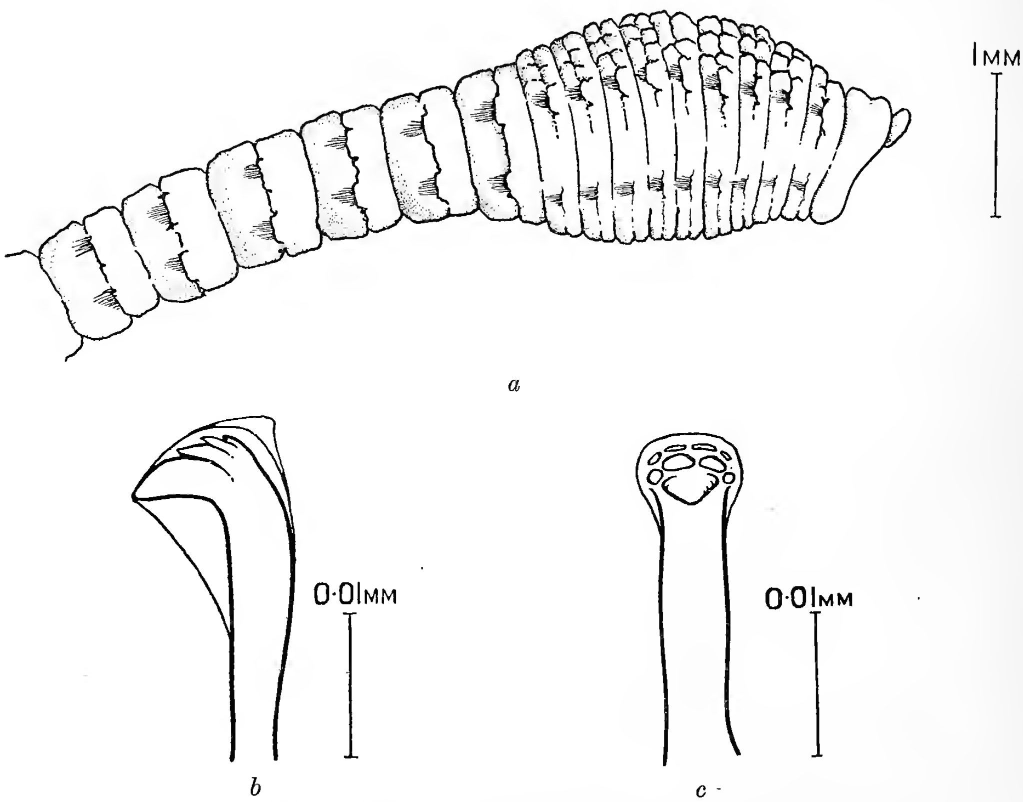
Genus *Dasybranchethus*, gen. nov.

Generic Diagnosis.—Capitellids with 16 thoracic segments, of which 15 are chaetigers. The thorax carries capillary bristles only, and the abdomen only hooks. No gills were seen.

Dasybranchethus fauveli, n. sp.

Occurrence.—Low Isles (1).

Description.—The specimen measures 90 mm. by 2 mm. at the widest part and 1 mm. at the narrowest; the length of the thorax is 6 mm. The body is cylindrical and contracted anteriorly, so that its thickest part is at about the 5th chaetiger.



Text-fig. 14.—*Dasybranchethus fauveli*. *a*, thorax seen from the side; *b*, hook in profile; *c*, hook, seen from in front.

The prostomium is tongue-shaped, and I see no eyes. It is retracted within the buccal segment so that only its tip can be seen. The buccal segment is slightly longer than the following segment, and appears to be considerably longer dorsally than it is ventrally. On the dorsal surface it is faintly divided into three incomplete rings, which disappear at the sides of the body. The remaining thoracic segments are biannulate (Text-fig. 14*a*). The first 9 chaetigers are of about the same length ; the 10th and remaining thoracic chaetigers are twice as long as the preceding thoracic chaetigers. The first 9 chaetigers have a rather irregular mosaic appearance on the dorsal surface, which disappears at the sides and on the ventral surface. The transition from thorax to abdomen is not sharply marked. There are 15 thoracic chaetigers, each with a pair of dorsal and a pair of ventral bristle-bundles, coming out of shallow pits and composed of simple capillary bristles.

The abdominal chaetigers are very numerous. Unfortunately the state of preservation is not good, the integument is spongy, and neither branchiae nor the limits of the segments can be discovered. There are hooks only in the abdomen, and they have 3 rows of teeth above the main fang (Text-fig. 14*b* and *c*).

There is no copulatory apparatus and, as far as I can tell, no anal appendage. The anus appears to be terminal.

Remarks.—The number of thoracic segments with only capillary bristles is so distinctive that in spite of the poverty of the material I felt justified in establishing a new genus for this specimen. It belongs to the group of Capitellids that are without copulatory apparatus, with only capillary bristles in the thorax and only hooks in the abdomen, and probably without gills.

Genus *Dasybranchus*, Grube.

Dasybranchus, sp.

Occurrence.—Low Isles ; Gen. survey ; 10.iv.29 ; F.7 (1).

Remarks.—This example consists of the thorax and one damaged abdominal segment of a *Dasybranchus*. It is probably a fragment of *Dasybranchus caducus*, Grube.

Family Amphictenidae.

Pectinaria (*Pectinaria*) *brevispinis*, Grube.

Grube, 1878, p. 210, pl. xi, fig. 2.
Nilsson, 1928, p. 64, fig. 20, a–g.

Occurrence.—Low Isles (1) ; Gen. survey ; Mangrove Park (1).

Remarks.—I have little doubt that the specimen in the Berlin Museum, redescribed by Nilsson, is in fact, as he assumes, the type of Grube's species. The present examples, which have the characteristic small first pair of tentacular cirri, agree fairly closely with Nilsson's account. There are, however, a few minor differences.

In the larger and better preserved of the two examples the paleae, of which there are two groups of 13, occupy more of the large cephalic plate, and the buccal tentacles

are much longer and more numerous than in Nilsson's account. Grube's type measured 90 mm. by 17 mm. over the segment bearing the paleae, the present specimen measures only 55 mm. by 14 mm.

As far as the 2nd chaetiger there are thick, fleshy, glandular folds running across the ventral surface. These are interrupted in the mid-ventral line by a cushion in the last branchiferous and the first chaetigerous segments. In the 2nd chaetiger this cushion is bilobed. Behind the 2nd chaetiger the glandular pads lie just below the feet and are widely separated. There are 9 anal hooks on each side.

Of the tubes, that belonging to the larger of the two specimens was preserved dry and has begun to crumble away. It measures about 90 mm. in length by 18 mm. in diameter at its widest part and 10 mm. at its narrow end. That belonging to the smaller of the two examples is not so large and is rather more curved. It measures 80 mm. in length by 14 mm. in diameter at its widest part and 7 mm. at its narrow end. Except that the present tubes are a little more curved, Nilsson's photograph (fig. 21*a*) of the tube of Grube's type closely resembles these from the Great Barrier Reef.

Pectinaria (*Pectinaria*) *antipoda*, Schmarda.

Nilsson, 1928, p. 69, figs. 22 and 23, with synonymy.
Pruvot, 1930, p. 78.

Occurrence.—Low Isles (1).

Remarks.—I rather doubtfully assign this example to Schmarda's species. It measures 35 mm. by 7 mm. It agrees in the main with Nilsson's account. There are 17 bristle-bearing and 13 hook-bearing segments. The posterior lateral appendages of the cephalic membrane are longer than the anterior.

The ventral glandular pad of the 2nd chaetiger is not in the present specimen divided into a series of lobes, but forms a wrinkled band across the segment, continuous except for a break in the mid-ventral line.

The scaphe resembles Nilsson's figure except that it is not so sharply constricted off from the last abdominal segment, and the length is rather greater relative to the breadth. The arrangement of the lappets and of the anal cirrus is, however, similar. The bristles and hooks agree with Nilsson's account.

The tube measures 62 mm. by 11 mm. at the wider end and 4 mm. at the narrower end. It is slightly curved and built of large sand grains, black, grey and white in colour. The surface is rougher than that of the tube of *P. brevispinis*. I see no shell fragments in its composition.

Family Terebellidae.

Loimia medusa (Savigny).

Fauvel, 1902, p. 94, text-figs. 43–45.
Hessle, 1917, p. 170, for synonymy.

Occurrence.—Low Isles (1); about 8 fms., mud, off West of Low Isles (1).

Remarks.—Of these two specimens one is large, measuring 90 mm. by about 10 mm. at its widest part for 40 chaetigers, and the other measures only 22 mm. for 65 chaetigers.

The small specimen is a more or less uniform pale brown in colour. In both the tentacles are lost. The larger specimen is pale yellow, generously mottled with black. In the anterior region there are black bands running parallel with the tori along the sides of the body and meeting in the mid-ventral line. Behind the last ventral scute these black bands become rapidly fainter and are soon indistinguishable from the general black mottling.

These specimens seem to be typical examples of the species. The exact posterior limit of the scutes is difficult to determine, but they seem to end at the 9th chaetiger. The larger specimen is accompanied by its tube, which is composed of shell fragments and pebbles.

In the present collection are three further examples of *Loimia*, which I have with hesitation treated as specifically distinct from the present specimens and attributed to *L. montagui*.

Loimia montagui (Grube).

Willey, 1905, p. 303, pl. vi, figs. 160–163, with synonymy.

Occurrence.—St. 9. "Magneta." 22.ii.29: Penguin Channel, 12–14 fms., in clean pit and on mud at sides (1).

St. 14. "Magneta." 7.iii.29; ½ mile S.E. Lizard Island, 19 fms., shell, gravel, rich *Halimeda* (1).

St. 23. "Magneta." 12.iii.29; in lee of Turtle Isles, 8 fms., mud and shell (1).

Remarks.—Of these three specimens, with an average measurement of 30 mm. by 4 mm. for 27 chaetigers, one is buff-coloured, one grey, and the third cream-coloured. In the last the black markings, so conspicuous in the other two, are so much faded as to be almost invisible. In the buff and in the grey specimens the black lateral stripes running parallel with the tori persist to about the 17th chaetiger; the continuation of these stripes across the ventral surface is only apparent for about the first six chaetigers, and is never so marked as in the larger example of *L. medusa* already described. Moreover, in every segment there is a very conspicuous black band across the back.

The teeth of the hooks are more numerous in these specimens than in *L. medusa*. In the thorax the hooks have usually six teeth, five large and one small. In the abdominal tori the number is six with a rudimentary seventh.

In two of the specimens the scutes appear to be continued to the 10th chaetiger, and in the third to the 9th. The numbering of the scutes in the Terebellids is apt to be misleading; except in unusually well-preserved specimens it is very difficult to decide exactly where they end; and the large shield behind the buccal segment, in which the scutes of several segments are usually fused, may be counted as a single scute; or when it is transversely wrinkled it may be counted as two or more scutes.

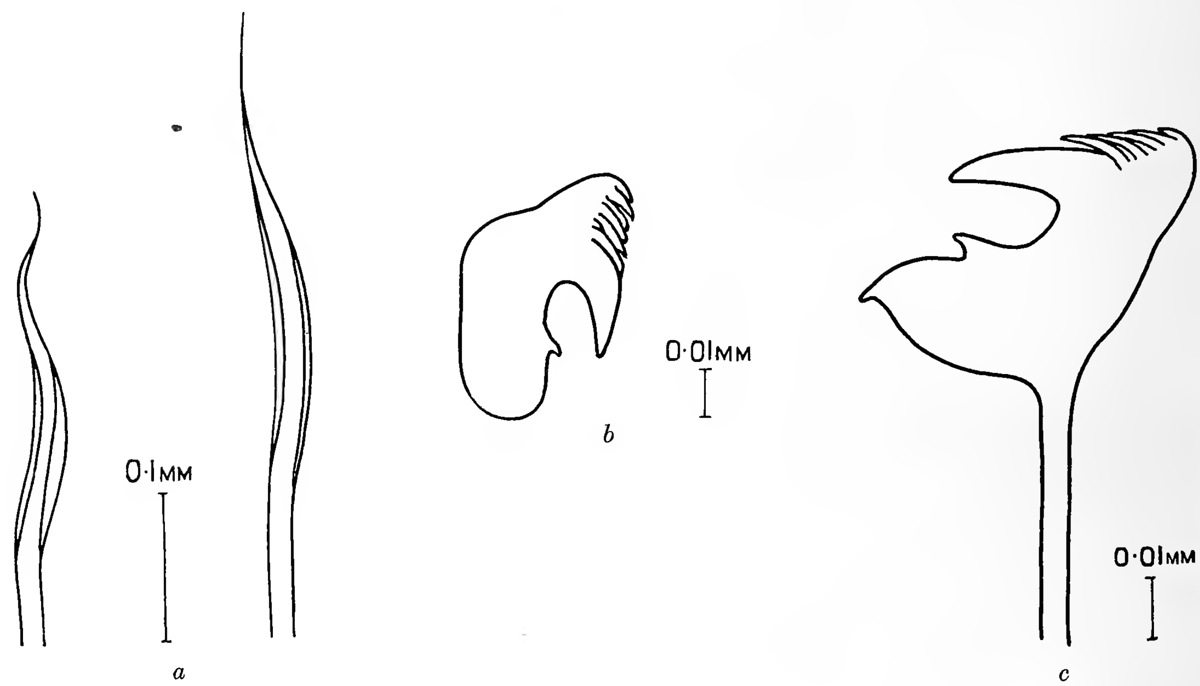
According to Willey, this species makes tubes of fine mud, very different from that of *L. medusa*. Otherwise the distinction between it and *L. medusa* is slender. *Loimia* is in need of revision, and this would necessitate an examination of Grube's type-specimens. Hessle (1917, p. 170) regards *L. annulifilis* as a synonym of *L. medusa*; Augener (1927, p. 142) treats it as a distinct species. The latter author (1926, p. 466) also thinks that *L. montagui* is probably a synonym of *L. medusa*.

Pista typha (Grube).

Terebella (Pista) typha, Grube, 1878, p. 232, pl. xii, fig. 4.
Pista typha, Hessle, 1917, p. 155.
Pista typha, Augener, 1927, p. 143.

OCCURRENCE.—Low Isles; from gut of an Enteropneust, probably *Balanoglossus carnosus* (1).

REMARKS.—The specimen has lost all its colour and measures 65 mm. by 2 mm. across the thorax. The thorax and the caudal end project from a parchmenty tube



TEXT-FIG. 15.—*Pista typha.* *a,* bristles; *b,* posterior thoracic hook; *c,* hook from 1st torus.

incrusted with sand grains. The example is partly digested and the details of the anterior segments cannot be studied. The tentacles are fairly numerous, but rather short and slender. The gills are mop-like, and indistinguishable from those of *P. cristata.* The left-hand member of the anterior pair is missing, and of the posterior pair the right hand member is considerably larger than both the remaining gills, the left-hand member of the posterior pair being about equal in size to the right-hand member of the anterior pair.

There are 17 pairs of notopodia; the bristles (Text-fig. 15*a*) are widely bordered and very like those of *P. cristata.* They end in a simple tip; some are much shorter than the rest and have a sickle-shaped appearance.

In the anterior thoracic segments the hooks are in simple rows; in the middle and posterior thoracic segments they are in single alternating rows. I could not ascertain the segment at which the change takes place. The uncini (Text-fig. 15*b*) appear to have

five or six teeth and several rows of denticles above the main fang. Hessle gives eight teeth above the main fang. The hooks of the first two or three tori have a posterior prolongation (Text-fig. 15*c*). In the abdominal region the tori are transformed into projecting pinnules. There are about 15 ventral gland-shields.

I have doubtfully attributed this very imperfect specimen to Grube's species. It agrees in the main with Grube's account. Grube gives 13 ventral scutes ; in the present specimen they cannot be counted accurately, but they appear to be about 15 in number. Grube describes the dorsal bristles as "haud limbatae" ; this is probably an oversight. Hessle describes the bristles of the examples attributed by him to Grube's species as widely bordered, as they are in the present specimen. Finally I find this species difficult to separate from the widely distributed *P. cristata.*

Family Serpulidae.

Spirobranchus giganteus (Pallas).

Spirobranchus giganteus, Ehlers, 1887, p. 286, pl. lvii, figs. 1–7.
Spirobranchus giganteus, Pruvot, 1930, p. 88 for synonymy.
Spirobranchus semperi, Mörch, Augener, 1914, p. 148 also for synonymy.

Occurrence.—Low Isles ; Gen. survey ; 21.iv.29 ; "The Thalamita flat." (1). Jukes's Reef, Outer Barrier (4).

Remarks.—These are typical examples of this common tropical species. The specimen from the Thalamita flat is rather more massive than those from the Outer Barrier, measuring 51 mm. from tail to gill-base by 5 mm. as compared with about 30 mm. by 3 mm., the average measurement of the Outer Barrier examples. Moreover the gills of the former specimen are of an intense blue colour, whereas those of the latter specimens are blue at their bases and pale pink further forward. The colour is, however, largely dependent upon the manner of preservation.

There is considerable variation in the breadth of the wings of the opercular peduncle, and no two specimens show exactly similar opercular horns. In some there are only a pair of branching, laterally directed horns, and in others there is a third and smaller horn pointing forwards and upwards (var. *tricornis* Mörch). I have examined the type of Baird's *Cymospira brachycerca*, and can add it to the synonymy of the present species.

Salmacina dysteri (Huxley).

Fauvel, 1927, p. 377, fig. 129*e–k*.
Augener, 1914, p. 160.

Occurrence.—Maer Island, Torres Strait, N.W. Reef Flat, outer edge. Numerous specimens.

Remarks.—A cluster of tubes indistinguishable from similar clusters found in the English Channel. It is difficult to remove a specimen intact, but such fragments as I have examined show nothing to distinguish them from the European species. According to Augener, the Australian *S. australis* Haswell is a synonym of this species.

REFERENCES (Polychaeta).

AUGENER, H. 1913. Polychaeta, I. Errantia. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. IV, pp. 65–304, pls. ii and iii, 42 text-figs.

—— 1914. Polychaeta, II. Sedentaria. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. V, pp. 1–170. pl. i, 19 text-figs.

—— 1922. Australische Polychaeten des Hamburger Zoologischen Museums. Arch. Naturgesch. LXXXVIII, Abt. A, H. 7, pp. 1–37, 33 text-figs.

—— 1926. Ceylon Polychäten. Jena. Z. Naturw. LXII, N.F. 55, pp. 435–472, 10 text-figs.

—— 1927. Polychaeten von Neu-Pommern. SitzBer. Ges. naturf. Freunde. Jahrg. 1926, pp. 119–152, 1 pl.

BENHAM, W. B. 1915. Report on the Polychaeta obtained by the F.I.S. " Endeavour " on the Coasts of New South Wales, Victoria, Tasmania and South Australia, I. Commonwealth of Australia. Fisheries. Biol. Res. V, pp. 173–237, pls. xxxviii–xlv, Sydney.

CHAMBERLIN, R. V. 1919. " Albatross " Polychaeta. Mem. Mus. Comp. Zool. Harv. XLVIII, pp. 514, 80 pls.

CROSSLAND, C. 1924. Polychaeta of Tropical East Africa, etc. Proc. Zool. Soc. Lond., pp. 1–106, 126 text-figs.

EHLERS, E. 1864–1868. Die Borstenwürmer, etc., Leipzig, pp. 748, 24 pls.

—— 1887. Reports on the Results of Dredging . . . in the Gulf of Mexico and in the Caribbean Sea, in the U.S. Coast Survey Steamer " Blake." Report on the Annelids. Mem. Mus. Comp. Zool. XV, pp. 335, 60 pls.

FAUVEL, P. 1902. Annélides Polychètes de la Casamance. Bull. Soc. Linn. Caen, Normandie. (5), V, pp. 59–105, 55 text-figs.

—— 1917. Annélides Polychètes de l'Australie méridionale. Arch. Zool. exp. gén. LVI, pp. 159–278, pls. iv–vi.

—— 1919. Annélides Polychètes de Madagascar, de Djibouti et du Golfe Persique. Arch. Zool. exp. gén. LVIII, pp. 315–473, pls. xv–xvii, text-figs. 1–12.

—— 1923. Polychètes errantes. Faune de France, V, pp. 488, 181 figs.

—— 1927. Polychètes sédentaires. Faune de France, XVI, pp. 494, 152 figs.

—— 1928. Annélides Polychètes nouvelles de l'Inde. Bull. Mus. Hist. Nat. XXXIV, Paris, pp. 90–96, and 159–165, 12 text-figs.

—— 1930. Annélides Polychètes de Nouvelle-Calédonie. Arch. Zool. exp. gén., LXIX, pp. 501–562, 9 text-figs.

GRAVIER, C. 1900. Contribution à l'Étude des Annélides Polychètes de la Mer Rouge. Nouv. Arch. Mus. Hist. Nat. Paris (4), II, pp. 137–282, pls. ix–xiv.

GRUBE, E. 1867. Anneliden. Reise der österreichischen Fregatte Novara. Zool. Theil. II, pp. 46, 4 pls.

—— 1878. Annulata Semperiana. Beiträge zur kenntniss der Annelt den fauna der Philippinen. Mém. Acad. sci. St. Pétersb. (7), XXV, No. 8, ix, pp. 300, 15 pls.

HESSLE, C. 1917. Zur Kenntnis der terebellomorphen Polychaeten. Zool. Bidr. Uppsala, V, pp. 39–258, 5 pls. 66 text-figs.

HORST, R. 1917. Polychaeta errantia. I. Siboga Exped. Monograph XXIVB, pp. 1–143, pls. xi–xxix.

—— 1924. Polychaeta errantia. II. Siboga Exped. Monograph XXIVC, pp. 145–198, pls. xxx–xxxvi.

KINBERG, J. G. H. 1865. Annulata nova. Öfvers. Vetensk. Akad. Förh. Stockholm, XXII, pp. 167–179.

MONRO, C. C. A. 1926. Polychaeta of the " Alert " Expedition, 1881–82. Families Hesionidae and Nereidae. J. Linn. Soc. London (Zool.), XXXVI, pp. 311–323, 11 text-figs.

—— 1928A. Notes on Some Unnamed Polynoids in the British Museum. Ann. Mag. Nat. Hist. (10), I, pp. 311–316, 4 text-figs.

—— 1928B. On some Polychaete of the Family Polynoidae from Tahiti and the Marquesas. Ann. Mag. Nat. Hist. (10), II, pp. 467–472, 4 text-figs.

NILSSON, D. 1928. Neue und alte Amphicteniden. Göteborg. Vetensk. Samh. Handl. XXXIII (4), iv, pp. 96, 30 text-figs.

POTTS, F. A. 1910. Polychaeta of the Indian Ocean. Pt. 2. Trans. Linn. Soc. London (2), Zool. XIII, pp. 325–353, pls. xviii–xxi.

—— 1914. Polychaeta from the N.E. Pacific, Chaetopteridae. Proc. Zool. Soc. Lond., 1914, pp. 955–994, 6 pls., 13 text-figs.

PRUVOT, G. 1930. Annélides polychètes de Nouvelle-Calédonie. Arch. Zool. exp. gén. LXX (1), pp. 1–93, 3 pls.

Treadwell, A. L. 1920. Polychaetous Annelids Collected by the U.S. Fisheries Steamer "Albatross" in the Waters adjacent to the Philippine Islands in 1907–1910. Bull. U.S. Nat. Mus., C. (1), pp. 589–602, 4 text-figs.

Willey, A. 1905. Report on the Polychaeta. Ceylon Pearl Oyster Fisheries, Suppl. Pt. IV, Rep. XXX, London, pp. 243–324, pls. i–viii.

OLIGOCHÆTA.

Pontodrilus bermudensis, Beddard.

v. F. E. Beddard, 'A Monograph of the Oligochaeta.' 1895, p. 469; also W. Michaelsen, "Oligochäten von verschiedenen gebieten," 'Mitt. naturh. Mus. Hamburg,' 1910, xxvii, p. 84.

Occurrence.—Low Isles; Gen. survey; 5.iv.29; "IM.4 and IM.5" (2); and 6.iv.29, Earthworm Spit (7).

Remarks.—I am indebted to my colleague, Col. J. Stephenson, F.R.S., for the determination of these specimens.

ECHIUROIDEA.

Of the two Echiuroids in the collection, one is in bad condition, and the other is an example of the curious form *Pseudobonellia*, already described from the Great Barrier Reef by Johnston and Tiegs. It has paired uteri and a male tube.

Pseudobonellia biuterina, Johnston and Tiegs.

v. T. H. Johnston and O. W. Tiegs, "*Pseudobonellia*, a New Echiuroid Genus from the Great Barrier Reef," 'Proc. Linn. Soc. New South Wales,' xliv, 1919, pp. 213–230, pls. ix–xi.

Occurrence.—Low Isles (1).

? *Thalassema vegrande*, Lampert.

v. A. E. Shipley, "On a Collection of Echiuroids from the Loyalty Islands, New Britain and China Straits," 'Willey's Zool. Results,' Pt. III, 1899, p. 352.

Occurrence.—Low Isles (1).

Remarks.—The condition of this specimen renders the examination of its internal anatomy impracticable. It bears a strong external resemblance to some examples from Rotuma attributed by Shipley to this species.

SIPUNCULOIDEA.

The Sipunculoids in this collection all belong to well-established tropical species, which have been studied by a number of authors, and I have nothing to add to the existing accounts. The majority were obtained from burrows in dead coral rock. For a discussion of the boring habits of Sipunculoids see Sluiter, 'Natuurk. Tijdschrift voor Nederl. Indie,' vol. l, 1891, p. 103.

Sipunculus robustus, Keferstein.

Selenka, 1883, p. 97, pl. xii, fig. 170.

OCCURRENCE.—Low Isles (1).

Sipunculus, sp. juv.

OCCURRENCE.—St. 5. "Merinda." 24.xi.28. Linden Bank, 37 fms.; bottom mud (1).

Siphonosoma cumanense (Keferstein).

Spengel, 1912, p. 261.
Sipunculus cumanensis, Selenka, 1883, p. 104, pl. xii, figs. 172–173.

OCCURRENCE.—Low Isles; Gen. survey; 10.iv.29; F.7 (2).

Aspidosiphon klunzingeri, Selenka and Bülow.

Selenka, 1883, p. 115, pl. xiii, figs. 187–189.
Shipley, 1899, p. 153.

OCCURRENCE.—Low Isles; Gen. survey; 4.iv.29; F.6 (4).—20.iv.29. The Sand Flat (1). Low Isles (1).

Aspidosiphon cumingii, Baird.

Selenka, 1883 p. 113, pl. xiii, figs. 183–186.

OCCURRENCE.—Low Isles; Gen. survey; 20.iv.29. The Sand Flat (1). Low Isles (1).

Aspidosiphon steenstrupii, Diesing.

Selenka, 1883, p. 116, pl. i, figs. 12–13; pl. xiii, figs. 190–192.
Sluiter, 1902, p. 18.

OCCURRENCE.—Low Isles (2). Coral rock, Low Isles (1).

Cloeosiphon aspergillum (Quatrefages).

Selenka, 1883, p. 126, pl. ii, figs. 23, 24; pl. xiv, figs. 214–216.
Sluiter, 1902, p. 30.

OCCURRENCE.—Low Isles; Gen. survey; 21.iii.29. Tripneustes Spit (1). Boulder Tract (3). Low Isles (18).

Physcosoma nigrescens (Keferstein).

Phymosoma nigrescens, Selenka, 1883, p. 72.
Physcosoma nigrescens, Fischer, 1927, p. 210.

OCCURRENCE.—Low Isles; Gen. survey; 21.iii.29. Tripneustes Spit (1). 22.iii.29. R.D. and R.16 (3).—11.iv.29, between Anchorage Reefs and Tripneustes Spit (1).—20.iv.29, The Sand Flat (1). Snapper Island (1). Low Isles (16).

Physcosoma pacificum (Keferstein).

Phymosoma pacificum, Selenka, 1883, p. 63, pl. i, fig. 6 ; pl. vii, figs. 111, 112.

Occurrence.—Low Isles (1).

Physcosoma scolops (Selenka and de Man).

Phymosoma scolops, Selenka, 1883, p. 75, pl. ii, fig. 17 ; pl. x, figs. 138–144.
Physcosoma scolops, Sluiter, 1902, p. 12.

Occurrence.—Three Isles ; 7.v.29, Beach rock (1). Low Isles, coral rock (1). Low Isles (10).

Physcosoma dentigerum (Selenka and de Man).

Phymosoma dentigerum, Selenka, 1883, p. 67, pl. i, fig. 7 ; pl. ix, figs. 118–123.
Physcosoma dentigerum, Sluiter, 1902, p. 11.

Occurrence.—Low Isles ; Gen. survey ; Boulder Tract (1). Low Isles (5).

REFERENCES (Sipunculoidea).

Fischer, W. 1927. Sipunculoidea und Echiuroidea. Michaelsen, W., und Hartmeyer, R. Die Fauna Südwest-Australiens. V, pp. 199–216, pl. ii.

Selenka, E. 1883. "Die Sipunculiden. Eine Systematische Monographie." C. Semper. Reisen im Archipel der Philippinen (2), IV, pp. xxxii, 131, 14 pls.

Shipley, A. E. 1899. Report on the Sipunculoidea. A. Willey. Zool. Results. pt. ii, pp. 151–160, pl. xviii.

Sluiter, C. P. 1902. Die Sipunculiden und Echiuriden der Siboga-Expedition. Siboga Exped. Monogr. XXV, pp. 53, 4 pls., 3 text-figs.

Spengel, J. W. 1912. Einige Organisations-verhältnisse von Sipunculusarten und ihre Bedeutung für die Systematik dieser Tiere. Verh. Deuts. zool. Ges., XXII, pp. 261–272.

INDEX

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 2

ENTEROPNEUSTA

BY

ETHELWYNN TREWAVAS, B.Sc.

WITH EIGHTEEN TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W.7
1931

Price Two Shillings and Sixpence

[*Issued 25th April*, 1931]

Made and printed in Great Britain.

ENTEROPNEUSTA

BY

ETHELWYNN TREWAVAS, B.Sc.

WITH EIGHTEEN TEXT-FIGURES.

INTRODUCTION.

The Enteropneusta are represented in the collections of the Great Barrier Reef Expedition by adults of two species and Tornaria larvae of at least seven species.

The adults are *Ptychodera flava*, Eschscholtz, and *Balanoglossus carnosus* (Willey), both members of the family Ptychoderidae. Both have a wide Indo-Pacific distribution, and each has a closely related species in the West Indies. *Ptychodera flava* has been

recorded from Sydney, New South Wales, and an identical or closely related species is known from the Abrolhos Islands, off Western Australia; but this is the first record of *Balanoglossus carnosus* from the Australian coast.

None of the Tornariae can be matched with its adult, and the elucidation of the life-histories of the Pacific Enteropneusta is a much-needed piece of work. Four species are here described as new; one of these is represented by fifty-nine specimens, but none of the others is described from more than five individuals.

Here I gladly express my gratitude to Miss A. B. Hastings, B.A., Ph.D., and to Capt. A. K. Totton, M.C., who separated some of these larvae from the plankton samples for me, while searching for members of other groups.

I am indebted to the Zoological Museum of the University of Cambridge for the loan of "cotypes" (? syntypes) of *Ptychodera asymmetrica*, Punnett, *Pt. viridis*, Punnett, and of the varieties of *Pt. flava* described by Punnett from the Maldives and Laccadives (except var. *muscula*). In addition, I have had for comparison syntypes of *Balanoglossus carnosus* (Willey), specimens of *Ptychodera flava*, collected and described by Willey, from New Caledonia, and a specimen of *Pt. bahamensis*, Spengel. These are in the collection of the British Museum (Natural History).

PTYCHODERA FLAVA, ESCHSCHOLTZ.

Ptychodera flava, Eschscholtz,* 1825, p. 740, pl. v, fig. 8. Spengel, 1893, p. 190, fig. P. Hill, 1897, p. 205. Willey, 1897, p. 165, pl. v; 1899, p. 227, pls. xxvi, xxviii, figs. 1*a*, 2–11, pl. xxix, figs. 12–15, pl. xxxii, figs. 66–68. Punnett, 1903, p. 644, pls. xxxvii–xl, xlii–xlvi. Spengel, 1903, p. 271, pls. xxiv–xxix; 1904*a*, p. 1, pl. i. Van der Horst, 1930, p. 195, figs. 62–64.

? *Balanoglossus tricollaris*, Schmarda, 1871–2, p. 273,† fig. (2nd edit. 1877, p. 368, fig. 237); = *Ptychodera ceylonica*, Spengel, 1893, p. 359, and chart; = *Ptychodera tricollaris*, Spengel, 1904*c*.

? *Ptychodera erythraea*, Spengel, 1893, p. 173, pl. x, figs. 1–20; 1904 *b*. Klunzinger, 1902. Gravier, 1905.

? *Ptychodera viridis*, Punnett, 1903, p. 656, pl. xxxvii, figs. 2, 6, 7; pl. xxxix, fig. 32; pl. xlii, figs. 17, 19.

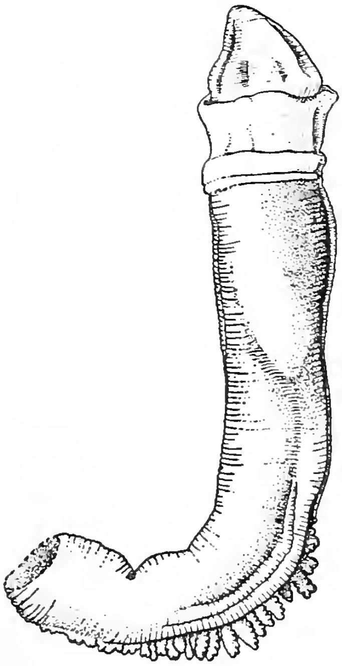
Eighteen specimens, of which nine, complete and apparently unregenerated, measure 27 to 50 mm. in total length; from the Sand Flat, Low Isles, taken 20th April, 1929. Also three specimens 60 to 65 mm. long, from Low Isles, taken in August or September, 1928.

As the species is very variable it has been thought worth while to give some description of the Low Isles material. The three August–September specimens are much more slender than the others, and have smaller proboscis and collar; although the branchial region is at least as long as in the others, the branchial basket is straight or only slightly sinuous in its course. They are evidently younger than the April animals—perhaps as much younger as the time between September, 1928, and April, 1929. Difference in method of preservation may further account for the difference in appearance. The following description applies to the April specimens only, but the measurements of the younger ones are included in the table.

* The type was incompletely described, and is not known to be now in existence.

† I am indebted for this reference to Spengel (1904*c*, p. 53). I have seen the second edition only.

External features (Text-fig. 1).—Proboscis usually conical, with fine transverse furrows and coarse longitudinal creases. Collar about equal in length to proboscis, with well-marked zones. "Racemose organ" well developed, simple and heart-shaped in young specimens, with three or four lobes in older. Length of collar 9 to $14\frac{1}{3}$ in total length, $\frac{3}{4}$ to $1\frac{1}{4}$ in length of branchial region. Origin of genital pleurae ventral in branchial region, rapidly becoming dorso-lateral behind it: pleurae continued in hepatic region as a pair of ridges between dorsal and lateral saccules. Gill-openings long, narrow, curved slits; branchial portion of pharynx an almost complete cylinder, communicating with the ventral portion by a narrow space between the parabranchial ridges, and exceeding it in girth. Branchial region separated from intestinal region by a short œsophageal tract to which the dorsal outline descends suddenly, rising as suddenly to about the same level



TEXT-FIG. 1.—*Ptychodera flava.* Incomplete specimen measuring 33 mm., seen from the left side. The hepatic saccules are more numerous than appears, for in the region of the large caeca every alternate one is crowded towards the middle line and is invisible in side view.

behind it (*cf.* Text-fig. 2, A to D). External hepatic saccules visible 2 to $7\frac{1}{2}$ mm. behind pharynx, extending for 6 to 12 mm.; saccules large, prominent, digitiform, mostly with well-developed anterior and posterior lobules; six to ten anterior saccules dark in colour; usually all but the smaller, anterior and posterior, saccules crowded into two ranks on each side.

The surface of the body is divided into annulations which are, as usual, somewhat irregular. These are much finer than in other specimens which I have examined (Willey's specimens from Isle of Pines; types of most of the varieties from Maldives and Laccadives). In this respect and in general appearance and size the Low Isles material comes nearest to *Pt. flava* var. *maldivensis*, Punnett (1903, p. 648, pl. xxxix, fig. 27). The width of the annular ridges, and especially of the intervening furrows, is no doubt dependent upon the degree of contraction of the specimen, and this upon the muscular development of

the individual, which is probably influenced by its mode of life and must increase with age. The method of preservation must also be taken into account; the Low Isles April specimens were fixed in Bouin's fluid.

Measurements of Specimens of Ptychodera flava *from Low Isles.* (1–17, *April specimens;* 18–20, *August–September specimens.*)

	Total length.	Pro-boscis length. (mm.)	Length of collar. (mm.)	Width of collar. (mm.)	Length of bran-chial region. (mm.)	Bran-chial to hepatic region. (mm.)	Hepatic region.* (mm.)	Post-hepatic region. (mm.)	Collar-length (times in total length).	Collar-length (times in branchial length).	Notes.
1	50	4½	4	5	5	5	9	25	13	1·25	..
2	50	3½	3½	5	3	7	10	24	14·3	0·9	..
3	48	4	3½	5	4	6½	9	24	13·7	1·1	..
4	39	3	3	4½	2½	4	8½	17	13	0·8	..
5	34	3	3	4½	3	3	11	13	12·3	1	..
6	28	3½	2½	3½	2½	2	6½	13	11·2	1	..
7	27	2¾	3	4	2¼	2¾	6	13	9	0·75	..
8	21	3¾	2½	4½	2½	..	..	..	8·4	1	Anal region probably regenerated.
9	..	4	3½	5½	4	8	10	20	..	1·1	Incomplete.
10	..	4½	4	5½	6	7½	12	..	..	1·5	,,
11	..	4	3½	4½	2½	3½	9	..	..	0·7	,,
12	..	2½	3	4	3	3½	8	..	..	1	,,
13	..	4	3	4	2½	3	6½	..	..	0·8	,,
14	25	3½	3½	4½	5	5	1½	7½	..	1·4	Hepatic region and anus probably regenerated.
15	..	2½	2⅓	3½	2	2½	6	..	..	0·8	Incomplete.
16	..	4	3¼	4½	3	..	..	..	..	0·9	,,
17	47	2	2	3½	1	3½	10	30	..	..	Anterior end probably regenerated.
18	65	3	3	3½	4	6	10	39	21·6	1·3	..
19	60	3	3	3½	3	5	13	33	20	1	..
20	..	2	3	3⅓	6	6	7	..	..	2	Incomplete.

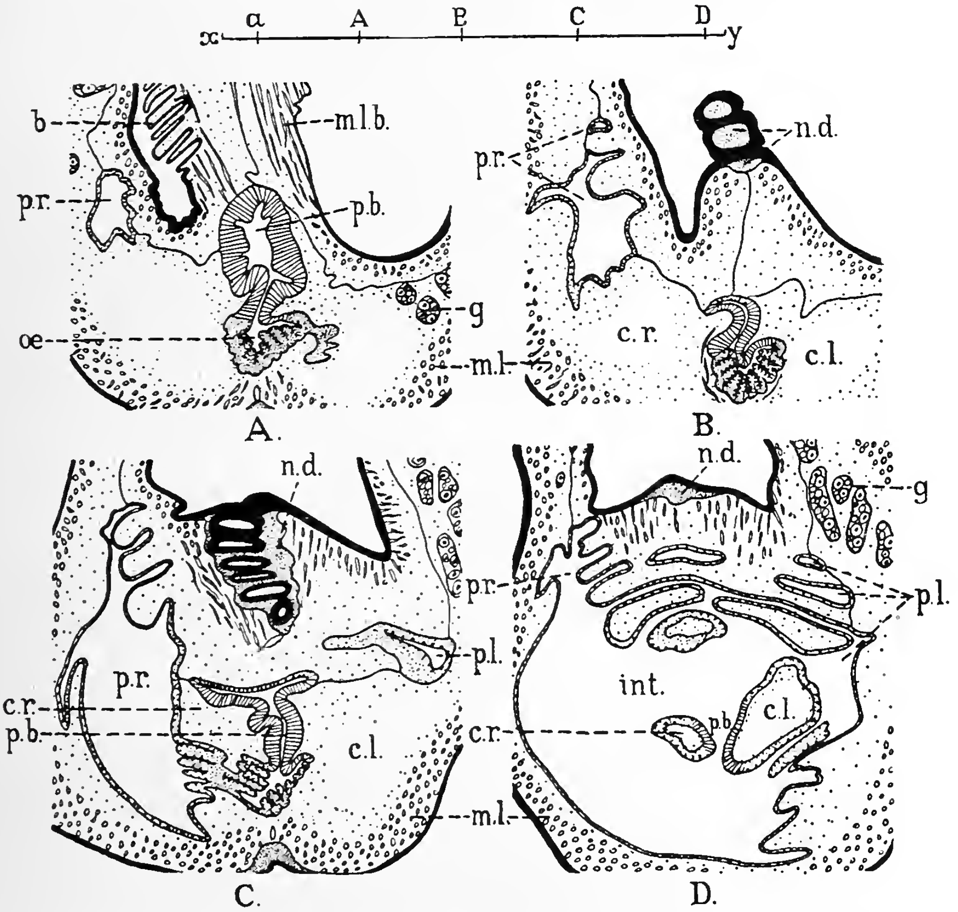
* External saccules.

Internal structure.—A single specimen, a male, 36 mm. long, was sectioned. Part of it was stained in picro-indigo-carmine and part in haematoxylin.

The *proboscis-musculature* is well developed, divided into groups by radial septa; circular connective-tissue fibres form a definite outline round the small anterior part of the proboscis-cavity. The left dorsal pouch of the proboscis-coelom is in open communication with the exterior by the *left proboscis-pore,* but the end-vesicle of the *right pore* does not communicate with the right dorsal pouch.

The *stomochord* gives off a pair of large lateral pouches without the mediation of a ventral caecum. The pouches have spacious cavities, which communicate by narrow channels near their posterior ends with the central cavity; the anterior end of the right pouch, still including a cavity, projects forward beyond the union of its wall with the central part of the organ. Anteriorly to this the ventral wall of the stomochord becomes thickened into an asymmetrical keel, into which the cavity presently descends, and which

forms the anterior end of the stomochord. In this specimen, therefore, in so far as a ventral outpushing of the stomochord can be spoken of, it is anterior to the lateral pouches, and the stomochord here attains a greater dorso-ventral thickness than between the pouches, where the depth is about one-fifth the length of the stomochord. This is the relative depth given by Spengel for *Pt. flava caledoniensis* (1903), p. 283, pl. xxiv, fig. 3), which he contrasts with *Pt. flava laysanica* (*loc. cit.*, pl. xxiv, fig. 4), where the ratio is $\frac{1}{6}$ to $\frac{1}{7}$. The shape of the organ in his two specimens is, however, entirely different, and is much



TEXT-FIG. 2.—A, B, C, D. Transverse sections through the post-branchial region of *Ptychodera flava*, to show the relations of the lateral intestinal pouches (× 24). The line *x*–*y* represents 1 mm. (on a larger scale than the figures), and the points A, B, C, D along it the positions of the corresponding sections relative to each other and to *a*, the anterior end of the right pouch. *b*, dorsal ends of posterior branchial bars ; *c.l.*, coelom of left, and *c.r.* of right side ; *g.*, gonad ; *m.l.*, longitudinal muscles ; *m.l.b.*, dorsal longitudinal muscles of branchial region ; *n.d.*, dorsal nerve ; *oe.*, oesophagus ; *p.b.*, post-branchial canal ; *p.l.*, left intestinal pouch ; *p.r.*, right intestinal pouch. The thin nervous layer beneath the epidermis is omitted between dorsal and ventral nerves.

longer as well as slimmer in *Pt. flava laysanica* than in *Pt. flava caledoniensis.* All these differences are probably within the range of individual variation, which is very considerable in the allied *Pt. bahamensis* (Van der Horst, 1924, p. 51).

The *collar nerve-cord* has a continuous lumen, which is prolonged into the base of the single *dorsal root*. The distal part of the root is solid and is fused with the epidermis,

which is invaginated to meet it; about halfway along the root is a transverse layer of yellowish pigment-granules. At the level of the root the nervous and epithelial layers of the floor of the neural cavity are thickened in the middle; in front of this the floor is invaginated, making the nerve-cord kidney-shaped in section; behind, it is roughly triangular. The perihaemal cavities contain much muscle, and embrace the ventral and lateral sides of the nerve-cord.

The " body " of the *skeleton* sends forward a pair of wings, which embrace the sides of the pouches of the stomochord. The " keel " is broad and excavated in front, narrow behind.

The *collar-pores* are typical in shape, and are associated with no thickening of the basement membrane such as is described in *Pt. bahamensis* (Van der Horst, 1924, p. 53.)

Sections of the branchial region are complicated by the sinuous course of the branchial basket. The ventral, non-perforated part of the pharynx is flattened, and its walls are thrown into folds, mainly as a result of contraction of the body-wall.

The *post-branchial region* differs somewhat from the description by Van der Horst (1930, p. 199) for specimens from Hawaii and New South Wales, and more resembles the usual condition for Ptychoderidae. It is probably as variable as most of the other internal characters which have been seized upon from time to time as specific. The parabranchial ridges consist of high cells with the nuclei near the periphery; in the upper part of the ridge the bases of these cells are clear and remain unstained, but in the lower part they become abruptly pink (in haematoxylin), and glandular. At the posterior end of the branchial region, as the gill-slits become shorter the parabranchial ridges rapidly increase in height by the increase of the glandular area, and present broad flat surfaces to each other. After the last gill-slit they meet above to form the roof of the gut and are continued as the " post-branchial canal." It is perhaps more accurate to say that there is no " post-branchial canal," if this is to be considered as the posterior, unperforated part of the branchial basket. This dorsal part of the post-branchial gut is really an extension of the canal between the parabranchial ridges. The intestine sends forward a large right and a smaller left lateral pouch, and these fuse with the dorsal wall of high-celled part of the gut, and with the ventro-lateral wall of the low-celled oesophageal portion, so as to enclose finger-like coelomic pouches, which project backwards into the intestine. (These are stated to be absent in his material by Van der Horst, *loc. cit.*) These are illustrated in Text-fig. 2, D (*c.r.*, *c.l.*), where the last traces of the high mucous epithelium can be seen forming their mesial walls.

The *hepatic region* is typical.

The *pygochord* is a thin, flexible sheet of tissue, for which it is difficult to imagine a skeletal function. It is probably important in preventing eversion of the posterior end of the gut.

SPECIMENS OF *PTYCHODERA FLAVA* FROM THE GALAPAGOS ISLANDS.

Seven specimens of *Ptychodera flava* in the British Museum were collected by Dr. C. Crossland on the Pacific cruise of the yacht " St. George " (Scientific Expeditionary Research Association), 1923–24. They are from the Galapagos (Stations 3, 4 and 6), and thus increase the known range of the species. Two complete specimens, 57 and

58 mm. long, are included, and also a specimen of 20 mm., which shows, from the proportions of its anterior end, and the fact that the "racemose organ" has seven lobes, that it has regenerated the posterior end. They are more slender than the April specimens from Low Isles, and their annulations are farther apart. Their proportions are shown in the following table :

Total length.	Proboscis.	Collar.	Branchial region.	Pharynx to hepatic cæca.	Hepatic region.
57 mm.	$2\frac{3}{4}$ mm.	$1\frac{2}{3}$ mm.	$5\frac{1}{2}$ mm.	$7\frac{1}{2}$ mm.	13 mm.
58* ,,	$1\frac{2}{3}$,,	1 ,,	<1 ,,	6 ,,	15 ,,
65 mm. (incomplete)	3 ,,	$2\frac{1}{2}$–3 ,,	6 ,,	4 ,,	42 ,,
35 ,, ,,	3 ,,	$2\frac{1}{3}$,,	$4\frac{1}{2}$,,	4 ,,	21 ,,
34 ,, ,,	$2\frac{2}{3}$,,	$2\frac{1}{2}$,,	4 ,,	3 ,,	19 ,,
32 ,, ,,	$1\frac{3}{4}$,,	2 ,,	$5\frac{1}{2}$,,	5 ,,	10 ,,
20† ,, ,,	$3\frac{1}{2}$,,	3–$3\frac{1}{2}$,,	6 ..	..	..

* Anterior end regenerated. † Posterior end regenerated.

REMARKS ON THE SPECIES OF *PTYCHODERA*.

Several species of *Ptychodera* have been described, some of them very fully ; nevertheless the definition of species is a very difficult matter. Punnett (1903), working on the material from the Maldives and Laccadives, found that almost every little colony of *Pt. flava* had its peculiarities, and described no less than seven varieties, as well as two which he regarded as distinct species. Willey (1899) recognized a macrobranchiate and a microbranchiate form as extremes of a series, and found one form to predominate at one locality in New Caledonia, the other at another. Spengel (1903 and 1904) recognized a variety from Laysan, Sandwich Islands, another from Funafuti, both of which he considered distinct from the New Caledonia form. Recently Van der Horst, in material from Sydney and Hawaii, found specimens to agree with most of the previously described " varieties " of the species, and also a specimen (from Hawaii) which, although he regards it as belonging to *Pt. flava*, has all the characters of *Pt. erythraea*, Spengel, 1893, a very large Red Sea form. As far as the " varieties " are concerned, it seems best to follow Van der Horst and to regard *Pt. flava* as a very variable species, many of whose organs exhibit growth changes throughout life. It seems to attain a greater size in some localities than in others. Spengel, as well as Van der Horst, describes very large specimens from the Sandwich Islands, and *Pt. erythraea* from the Red Sea is probably, as Van der Horst suggests, also identical with *Pt. flava*. *Ptychodera viridis*, Punnett (1903, p. 656, pls. xxxvii, xxxix, XLII) was described from a few very small specimens, which, apart from juvenile characters, have nothing but their colour to separate them from *Pt. flava*.

Ptychodera asymmetrica, Punnett (*loc. cit.* p. 657, pl. xxxvii, figs. 1, *g* ; pl. xlvi, figs. 52, 56, 58), described from eight specimens, in all of which the right genital pleura is devoid of gonads, may be distinct.

Ptychodera tricollaris (Schmarda), from Ceylon, is insufficiently described, and may be identical with *Pt. flava*.

Pt. pelsarti, Dakin (1916), from the Abrolhos Islands, off Western Australia, differs from *Pt. flava* in having the branchial basket smaller than the ventral part of the pharynx

with which it communicates by a wide channel between the parabranchial ridges. The suggestion that this is a juvenile character is supported by the association with it of weak musculature, a small and relatively simple "racemose organ" and a keeled skeleton. *Pt. flava* var. *saxicola,* Punnett (1903, p. 650, pl. xliv fig. 38) has a similar branchial region, and an incomplete specimen, including the posterior half of the pharynx, which I have examined, is as large or even larger than specimens of *Pt. flava* with long, curved gill-slits. It is possible that *Pt. flava* var. *saxicola* and *Pt. pelsarti* are identical, and distinct from *Pt. flava.*

Pt. bahamensis, Spengel, 1903, was originally described from a very young specimen, but Van der Horst (1924, pp. 50–55, pl. iv ; pl. vi, figs. 1, 9 ; pl. vii, figs. 7, 10, 12, 14) has described a large series of specimens of all sizes, up to more than 112 mm. in length, and these show growth changes similar to those of *Pt. flava.* It is difficult to see in what the two species differ. A small specimen in the British Museum, received from Dr. Van der Horst, does not differ externally from specimens of *Pt. flava* of a corresponding age. Van der Horst states (1924, p. 51) that the genital pleurae decrease in width behind the branchial region more gradually in *Pt. bahamensis* than in *Pt. flava* ; but there is much variation in *Pt. flava* in this respect, the extremes of which are illustrated in Willey's figures (1899, pl. xxvi, figs. 2, 3) of his macrobranchiate and microbranchiate forms. It is possible that short branchial region and rapid passage from broad to narrow pleurae may be expressions of a general stumpiness of form. The structure of the funnels of the collar-pores appears to be more complicated in *Pt. bahamensis* than in *Pt. flava.* Negative evidence in favour of the distinctness of *Pt. bahamensis* is found in the fact that, up to the present, identical Tornaria larvae of the type ascribed to *Ptychodera* have not been found in the Pacific and West Indian waters.

BALANOGLOSSUS CARNOSUS (WILLEY).

Ptychodera carnosa, Willey, 1899, p. 248, pl. xxvii, fig. 6 ; pl. xxviii, fig. 1*b* ; pl. xxix, figs. 16–19 ; pl. xxx, figs. 20–23.

Balanoglossus carnosus, Punnett, 1903, p. 640, pl. xxxvii, fig. 3. Maser, 1913. Van der Horst, 1930, p. 187, figs. 56–59.

The material from Low Islands consists of eight fragments, only one of which includes the anterior end. This has the following measurements :

Length of proboscis	10 mm.	
Length of collar	15 ,,	
Posterior diameter of collar	13 ,,	
Length of branchial region	40 ,,	(incomplete)
Width of each genital pleura, about . . .	5 ,,	

The base of the proboscis is narrower than its anterior part, and is surrounded by the anterior part of the collar, which leaves only 3 mm. free ventrally and about 7 mm. dorsally.

The collar consists of the usual three raised zones separated by two furrows ; the narrow posterior ridge is 1 mm. wide, the middle ridge 3 mm. ; the anterior region is constricted about midway in the total length of the collar in the manner characteristic of the species.

The gill-pouches have ventral caeca and open by small, oval or rectangular pores. The branchial portion of the pharynx is smaller in girth than the ventral part, from which it is separated by a narrow channel between prominent parabranchial ridges.

The remaining fragments are parts, 35 to 120 mm. long, about 9 mm. in diameter, of the posterior intestinal region of animals of about the same size as that represented by the anterior fragment. The largest, which includes the anus, contained a portion of another Enteropneust, a tubicolous polychaet in a tube of coarse sand 45 mm. long and about $3\frac{1}{2}$ mm. in diameter, a complete sand-anemone, a fly and some loose sand. The fact that most of these were in good condition suggests that the animal was making a hurried departure and swallowing every obstacle; it is possible that this heavily-laden posterior end was voluntarily discarded, as autotomy is known to occur in the species. The severed end of this fragment and of another were turned inside out and rolled back like a sleeve. Willey (1899, p. 256) states "an isolated piece, two or three inches long, of the abdominal region will always turn itself inside out," and, on the same page, "It breaks up into longer or shorter lengths upon slight provocation."

Dr. T. A. Stephenson tells me that "*Balanoglossus carnosus* was much more widespread" than *Ptychodera flava* "and was common on most sandy places; its presence could always be detected by its characteristic castings."

The species is recorded from Blanche Bay, New Britain (Willey), Minikoi and Hulule, Maldives (Punnett); Amboina and Kei Islands, E. Indies (Van der Horst), and Misaki, Japan (Van der Horst, and, *fide* Stiasny, 1928, Miyashita). This is the first record from the Australian coast.

The difficulty of recognizing good specific characters in adult Enteropneusta has been referred to in the case of *Ptychodera flava*. A similar problem surrounds *Balanoglossus carnosus*, which is one of a group of five described species, agreeing in the reduction of the proboscis, the enlargement of the collar (which supplements and largely replaces the proboscis as a burrowing organ), in the possession by the stomochord of dorso-lateral as well as ventral extensions, and by the gill-pouches of ventral caeca,* and in the abrupt ending of the genital pleurae. The other four species are *B. numeensis*, Maser, 1916, from New Caledonia, *B. biminiensis* and *B. jamaicensis* (Willey), 1899, from the West Indies, and *B. gigas*, Fr. Müller (Spengel, 1893), from Brazil. The resemblances of these five species to each other are much more remarkable than their differences, which reside in features shown by every fresh investigation to be subject to individual variation and growth changes. The differences between *B. carnosus* and *B. numeensis*, tabulated by Maser (*loc. cit.*, p. 422), are mainly dependent on the weaker development of the proboscis musculature, its skeleton and blood-supply in *B. numeensis*, the specimens of which were very much smaller than those of *B. carnosus*; it is possible that the shape of the collar and of the collar-pore are also connected with size. The length of the branchio-hepatic transition was compared in one specimen only of each species, and given as 10 mm. in *B. carnosus* (from Willey) and *nil* in *B. numeensis*. In Willey's figured specimen, now in the British Museum, it is only 2 mm. as preserved, so that individual variation is enough to account for the difference. *B. jamaicensis* was described by Willey from one poorly preserved, very large specimen, and Van der Horst (1930) considers it probably identical with *B. biminiensis*; this species resembles *B. carnosus* in all important characters, the chief differences being in size and correlated features. Of *B. gigas* less is known.

* *Balanoglossus clavigerus* also has gill-pouches with ventral cæca.

It is possible that we have to deal here with one circumtropical species. On the other hand, the evidence, admittedly incomplete, of the *Tornaria* larvae suggests that at any rate there are distinct West Indian and Indo-Pacific species. The solution, if there be one, of the problem may be arrived at by two methods of attack : (1) the examination of a large series of adults of different sizes from each locality, and (2) the working out of the life-histories. It is possible that the only absolute specific characters are larval, or even that the same species may produce slightly different larval forms in different localities.*

TORNARIA LARVAE.

Introduction.

The plankton samples include 79 specimens of Tornaria larvae, representing at least seven species. Of these, 71 specimens, of four species, are from the weekly plankton station, 3 miles east of Low Isles ; the others were taken on one day at two stations outside Trinity Opening. With the exception of one specimen of the most abundant species, taken in April, all those from the weekly station were taken from the end of December, 1928, to February, 1929. Hauls were taken at Trinity Opening in August, September, October and November, but only the October hauls yielded Tornariae, and these were isolated specimens, of different species and ages, none of which appears to be identical with either of the species from nearer Low Isles. Speculations as to a restricted breeding season are hardly warrantable from these results.

The question arises as to which, if any, of the four species taken near Low Isles are the larvae of the two species in the collection of adults. The most abundant larva (*T. cairnsiensis*) may be that of *Balanoglossus carnosus* (but see below, p. 62). Stiasny-Wijnhoff and Stiasny (1926) conclude, on grounds of geographical distribution, that the larva of *Ptychodera* is a large, tentaculate Tornaria, with the coelom far from the gut and attached to the body-wall. The absence of a larva of this type from the collection is not enough to disprove this suggestion, but too little is known of the geographical distribution of the group to allow much weight to be attached to a theory based on such evidence alone.

In studying this collection full use has been made of the treatise on Tornaria larvae by Stiasny-Wijnhoff and Stiasny (1927)—a work indispensable to a student of the group.

Terminology.

As is well known, the Tornaria larva has, as well as a circular ring of cilia, two ciliated bands, a praeoral between the mouth and the apical organ, and a postoral, which loops round the body to meet the apical organ from the dorsal side. Between them is the oral field. In early stages these bands are relatively simple, but later they become thrown

* Calman (1909, p. 326) says of the Stomatopoda—"the larval forms of the various species differ from each other more widely than do the adults." *Rana temporaria* and *Rana arvalis* are so similar as adults as to have been long confused, but their tadpoles are easily distinguished (Boulenger, 1910, pp. 205–6). The same is true of *R. tigrina* and *R. cancrivora* (Boulenger, in Boulenger and Annandale, 1918, p. 65). Giard (1891 and 1892) gives several examples, from Coelenterata, Echinodermata, Crustacea, Insects and Tunicates, of animals of the same species which produce two or three forms of larvae according to environment or habits, and remarks that if one of these "poecilogonic varieties," as he terms them, should be accompanied by a difference, however small, in the adult, systematists would not hesitate to make it a distinct species (1892, p. 1551).

into a series of loops, between which the oral field forms a system of grooves, interdigitating with a corresponding system of ridges of the praeoral and postoral fields. The intricacy of the pattern so formed and the relative constancy of its main features necessitated the terminology introduced by Spengel (1893, pp. 371–73). Subsequent authors, including Stiasny-Wijnhoff and Stiasny, have followed Spengel in applying the term "Lobus" to branches of the groove-system of the oral field, whereas it is more descriptive of the intervening ridges and their outgrowths. For this reason, and also because some of the German words used cannot be literally rendered in English, I have not adopted this terminology as it stands. I have replaced the word "Lobus" by "groove," and translated "Sattel" as "ridge." Stiasny-Wijnhoff and Stiasny (*loc. cit.*, p. 49) reserve the term "Tentakel" for long, narrow, fringe-forming outgrowths of the edge between groove and ridge, while blunter processes, whether they turn outwards, as in *T. weldoni* and *T. setoensis*, or are flat, are called "sekundäre Sättel" and their possessors accordingly "nicht tentakulaten." In *T. setoensis* and similar larvae the outgrowths may project freely for half their length or more and may overlap each other; their attached basal parts alone have short secondary grooves between them. I propose for them the term "lobate tentacles." The word "lobate" is intended in a descriptive sense, but it fits equally well into the German terminology because of the association with "lobate tentacles" of short secondary grooves ("sekundäre Lobus"). Thus the secondary loops of the ciliated bands produce three types of structures, which grade into each other:

(i) Secondary ridges, with equal secondary grooves.
(ii) Lobate tentacles, with smaller secondary grooves.
(iii) Tentacles, with secondary grooves absent or very small.

Of these the last is the most specialized, as Stiasny-Wijnhoff and Stiasny point out.

A tabulated comparison of the German terminology and that adopted here follows. It is illustrated in Text-fig. 10 of this paper and the diagram of Stiasny-Wijnhoff and Stiasny (*loc. cit.*, p. 58).

Stiasny-Wijnhoff and Stiasny (= Spengel, with additions).		In this paper.	
Oralfeld	Mundbucht	Oral arch	Oral field.
	Lateral lobus	Inferior lateral groove	
	..	Superior lateral groove	
	Primärer ventraler Lobus	Ventral groove	
	Obere primärer dorsaler Lobus	Superior dorsal groove	
	Unterer dorsallobus	Inferior dorsal groove	
	Sekundärer Lobus	Secondary groove	
Praeoralfeld	Mittelstreifen des Praeoralfeldes	Praeoral mid-ventral ridge	Praeoral field.
	Primärer Sattel (ventraler)	Ventro-lateral ridge	
Postoralfeld	Primärer Sattel (dorsaler)	Dorso-lateral ridge	Postoral field.
	Mittelstreifen des Postoralfeldes	Mid-dorsal ridge	
	Lateralsattel	Lateral ridge	
	Ventralband	Ventral belt	
	Ventralsattel	Postoral ventral ridge	
	Sekundärer Sattel	Secondary ridge or Lobate tentacle.	
	Tentakel	Tentacle.	

The names of larval stages are taken from Stiasny-Wijnhoff and Stiasny (1927).

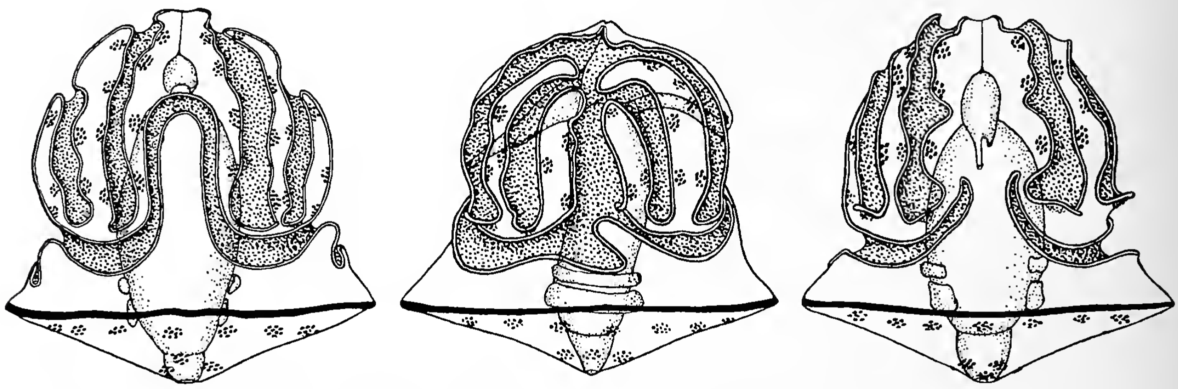
The number of tentacles or lobate tentacles appears to be a useful diagnostic character, and may be expressed in a formula. Thus, where V = ventral groove, L = superior lateral groove, D = superior dorsal groove, and the tentacles on the ventral border of each groove are enumerated before those on the dorsal border, the formula for *T. cairnsiensis* (Text-fig. 9) is V. 6–8, 6 ; L. 4, 4 ; D. 5 or 6, 5 or 6. Such a formula has the advantage over a diagram of showing the range of variation.

In naming new larval forms, the custom is followed of using " *Tornaria* " as though it were a generic name, and of deriving the specific name from that of one of its collectors, or of the locality where it was taken. A new name is given only when the Krohn-stage can be described and is clearly distinct from any other known Krohn-stage.

1. *Tornaria russelli*, sp. n. (Text-fig. 3).

Advanced Krohn-stage of a non-tentaculate larva.

Height $1\frac{1}{3}$ mm. ; diameter $1\frac{1}{3}$ mm.



TEXT-FIG. 3.—*Tornaria russelli.* Holotype. Ventral, right lateral and dorsal views (× 36). Oral field, in this and subsequent figures, indicated by dark shading.

Anterior part of larva bell-shaped, with greatest diameter at ciliated ring ; anal field a shallow inverted cone, the axis of which comprises $\frac{1}{5}$ of the total height. Praeoral field of a modified anchor-shape, with each lateral arm of the anchor forked to its base ; anterior part of postoral field similar.

Oral arch high, with parallel limbs ; upper and lower lips parallel. Inferior lateral groove triangular, with ventrally directed apex, bounded by a narrow, dorsally directed ridge on its ventral side and a scarcely perceptible eminence dorsally. Inferior dorsal groove long, with dorsal end turned upwards near middle line. Ventral, and superior dorsal grooves forked to correspond with the ridges. Praeoral and postoral ciliated bands with a wavy course, producing low secondary ridges and grooves ; on each side of mid-dorsal ridge a series of four secondary ridges, of which the lowest is largest and is separated from the next by a rather deep groove. Cushions of small (? pigment-) cells present on the ridges, principally on the secondary ridges, but not on the postoral ventral ridge or the ventral belt ; in addition, a ring of fifteen such cushions behind the ciliated ring and a group of nine round anus.

Proboscis-coelom ending in a right blind sac and a left dorsal pore. Paired collar- and trunk-coeloms close to gut, cylindrical, separate from each other. Oesophagus short, almost horizontal ; stomach cylindrical ; hind-gut small, conical.

A single specimen, from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m., with the coarse silk tow-net (vertical haul, 180 metres of wire out).

I have associated with this species the name of F. S. Russell, Esq., D.S.C., D.F.C., B.A., who was in charge of the plankton investigations of the expedition.

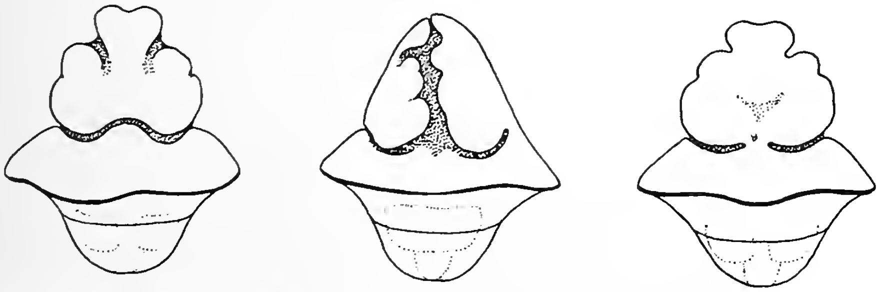
This species is distinguished from all others by the deeply forked arms of the praeoral and postoral, anchor-shaped fields. It shows affinity to the group of Tornariae associated by Stiasny-Wijnhoff and Stiasny with the genus *Glandiceps*, and including *Tornaria menoni* Stiasny, from Madras (Ramunni Menon, 1903, p. 130, pl. x, figs. 5, 6 ; also Stiasny-Wijnhoff and Stiasny, 1927, p. 118, figs. 44, 45). *T. dubia*, Spengel, from the Mediterranean (1893, p. 378, pl. xxii ; also Stiasny-Wijnhoff and Stiasny, 1927, p. 98, figs. 30–36), *T. mortenseni*, Stiasny, from Japan (1922, p. 124, figs. 1–5), and *T. ijimai*, Stiasny, from Japan (1928, p. 88, fig. 19 ; also below). *T. menoni* and *T. ijimai* have pigment-spots resembling the cushion-like groups of cells of *T. russelli* (which are colourless as preserved), but differing from them in details of distribution. The inferior lateral groove, which is invisible in a dorsal view of *T. russelli*, is situated so far ventrally in *T. menoni*, *T. dubia* and the type of *T. ijimai* that Stiasny has not identified it as a lateral groove. The forking of the ventro-lateral ridge is characteristic of the same three species, but the ridge and its divisions are very short, and there is no counterpart of the similar forked dorso-lateral ridge.

2. ? *Tornaria ijimai*, Stiasny (Text-fig. 4).

1928,* p. 88, fig. 19.

Below is a description of an opaque larva, probably of this species.

Height nearly 1 mm. ; diameter $\frac{4}{5}$ mm.



TEXT-FIG. 4.—*Tornaria ijimai*. Ventral, left lateral and dorsal views. (× 40.)

Shape a double cone. Ciliated ring much greater in diameter than any other part of larva ; axis of anal field about $\frac{2}{5}$ total height. Praeoral field divided by a pair of grooves of uncertain extent (somewhat damaged) into a mid-ventral and a pair of ventro-lateral ridges ; each ventro-lateral ridge subdivided by a narrow, shallow, secondary groove. Oral field narrow, consisting of a low oral arch, deep superior lateral grooves and long inferior dorsal grooves, approximating dorsally ; inferior lateral grooves small, triangular (preserved on one side only) ; superior dorsal groove represented by two indentations of the dorso-lateral margin of the postoral field. Ventral belt of postoral field broad,

* In this paper indebtedness is acknowledged to the manuscript of Miyashita. *T. ijimai* is described by Stiasny from Miyashita's reproductions of sketches made 15th July, 1895, by Prof. Ijima.

inclined at about 45° to plane of ciliated ring. A secondary circumanal ring about midway between this and anus.

Proboscis-pore to left of middle line ; shape of proboscis coelom not visible. Paired trunk-coelom present, apparently related to gut ; collar coelom ?.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m. in the 1 metre coarse silk net. (Vertical haul, 180 metres of wire out.)

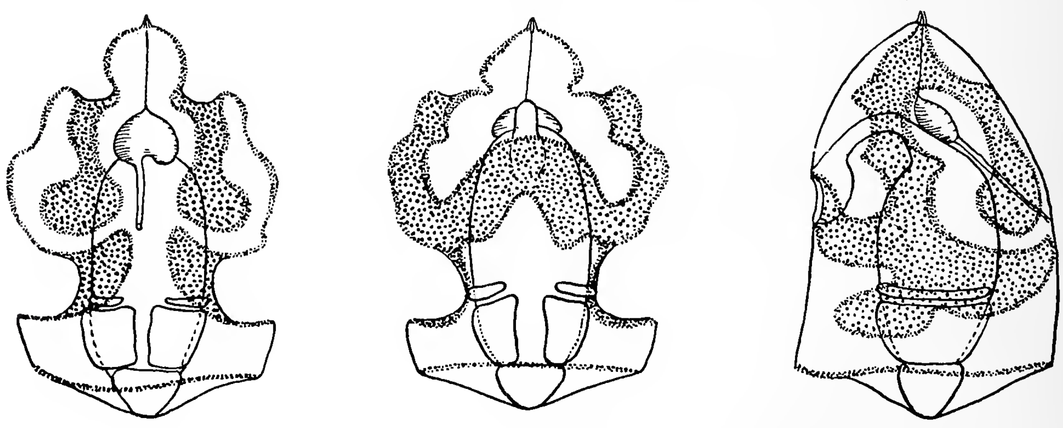
This specimen resembles *T. ijimai*, from Misaki, Japan, in the shape of prae- and post oral and anal fields, and in the low oral arch. Its opacity, the presence of a paired coelom, the narrowness of the grooves of the oral field and the greater diameter of the ciliated ring are differences indicating a more advanced stage of development. Other differences are the absence of pigment (as preserved), and the position of the inferior lateral groove ; this is more ventral in *T. ijimai*, as in *T. dubia* and *T. menoni*, and gives the postoral ventral ridge a peculiar triangular shape. The condition here described may have been arrived at by the reduction of the groove-system with age, but the specimen is not well enough preserved to allow stress to be laid on this character. This Tornaria is therefore considered to be identical with or closely related to *T. ijimai*, Stiasny.

3. *Tornaria colmani*, sp. n. (Text-figs. 5, 6).

Krohn-stage of a non-tentaculate larva.

Height about $\frac{5}{6}$ mm. ; diameter about $\frac{1}{2}$ mm.

Larva somewhat barrel-shaped, with shallow anal field, and with greatest diameter in region of longitudinal ciliated bands. Praeoral field five-lobed, the median lobe a little



Dorsal. Ventral. Lateral.

TEXT-FIG. 5.—*Tornaria colmani*. Late Krohn stage. (× 60.)

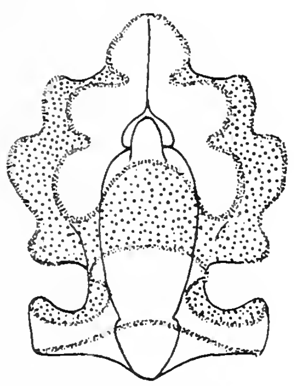
bigger than the lateral. Anterior part of postoral field anchor-shaped ; mid-dorsal ridge with a pair of broad, low secondary ridges ; dorso-lateral ridge with wavy outline, producing one secondary ridge on its dorsal border, two on its ventral. Oral field broad, oral arch low and wide. Postoral mid-ventral ridge triangular in older larva (Text-fig. 5), flat in younger (Text-fig. 6). Inferior lateral groove produced ventrally, bounded by a long, horizontal inferior lateral ridge on the ventral side, and a low prominence dorsally. Inferior dorsal groove broad and deep. Ventral belt of postoral field vertical or becoming narrower towards main ciliated ring. No secondary circumanal ring visible.

Proboscis-coelom a heart-shaped sac, the left lobe of which is connected by a narrow duct with the single left proboscis-pore, and the apex by a slender strand with the apical organ. No paired coelom in the younger larva: a large paired trunk-coelom and a narrow collar-coelom in the older larva, close to posterior part of stomach. Mouth wide, leading by a funnel-shaped cavity into the narrow oesophagus; stomach cylindrical, long, its end projecting into the conical hind-gut.

Two specimens, syntypes of the species, representing early and late Krohn-stages, from Station 40 (3 miles East of Low Isles, 6th February, 1929), taken at 3.50 p.m. in the fine silk tow-net.

The specific name refers to J. S. Colman, Esq., B.A., member of the Expedition, who worked on the animal plankton.

This larva evidently belongs to the "*Glandiceps*-type" of Stiasny-Wijnhoff and Stiasny. It resembles *T. dubia*, Spengel, in the shape and extent of the postoral field and inferior lateral groove, in the shallowness of the anal field and the absence from it of a secondary ciliated ring, but differs from it in the shape of the praeoral field, which is more



TEXT-FIG. 6.—*Tornaria colmani*. Early Krohn stage. (× 60.)

like that of *T. ijimai*. The general resemblance to *T. mortenseni*, Stiasny (1922, p. 123, figs. 1–5), is striking, but the oldest stage of this described by Stiasny is a young Krohn-stage, and its height is given as $1\frac{1}{2}$ mm.; other differences are found in the shape of the stomach and of the inferior lateral groove, and in the presence in *T. mortenseni* of a secondary circumanal ring. The Barrier Reef larvae are therefore considered to represent a distinct species, related to *T. mortenseni*.

4. *Tornaria yongei*, sp. n. (Text-fig. 7).

A non-tentaculate larva in Krohn-stage.

Height = diameter = 1 mm.

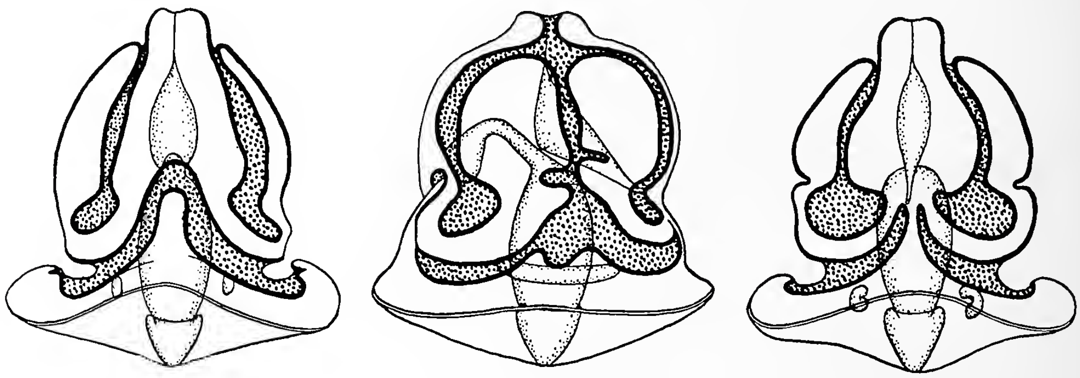
Anterior part of larva somewhat compressed laterally; greatest diameter at ciliated ring; postoral and anal fields meeting at a rounded edge, anal field a shallow cone. Praeoral and anterior part of postoral fields anchor-shaped. Oral arch rather low, narrow, oral field narrow, with shallow inferior lateral grooves, and long inferior dorsal grooves, nearly meeting mid-dorsally; superior lateral groove with a small secondary groove on each side, indenting the lower ends of ventro-lateral and dorso-lateral ridges; ventral groove and superior dorsal groove expanded at their lower ends. Apical organ situated

in a slight depression between the raised upper ends of praeoral and postoral fields. No secondary circumanal ring visible.

Proboscis-coelom fairly large, transparent, with a single, left dorsal pore. Paired trunk-coelom present, very transparent, cylindrical, curved; situated far from gut and almost equally far from body-wall. Mouth funnel-shaped; stomach small, cylindrical, projecting into the conical hind-gut.

A single specimen, from Station 40 (3 miles East of Low Isles, 6th February, 1929), taken at 3.50 p.m. in the fine silk tow-net.

I have associated with this species the name of C. M. Yonge, Esq., D.Sc., Ph.D., leader of the Expedition.



TEXT-FIG. 7.—*Tornaria yongei*. Holotype. (× 45.)

This larva belongs to Type I of Stiasny-Wijnhoff and Stiasny, and most closely resembles *T. bournei*, Stiasny (Bourne, 1889), which, with similar larvae, is considered by Stiasny-Wijnhoff and Stiasny (1927, pp. 83, 154, 157, 187) to belong to the genus *Glossobalanus*. *T. yongei* may possibly be the larva of *Gl. ruficollis* or *Gl. hedleyi*, both of which are known from this region.

5. *Young Non-tentaculate* Tornaria *Larvae.*

Five specimens, $\frac{2}{3}$ to $\frac{3}{4}$ mm. high, $\frac{1}{2}$ mm. in diameter, are too young to be assigned to any known species or to be described as new. They represent Metschnikoff- and early Krohn-stages of a Tornaria, probably of Type I of Stiasny-Wijnhoff and Stiasny. The following is a brief description of them.

Praeoral and anterior part of postoral fields anchor-shaped. Oral arch low, wide. Grooves of oral field fairly wide; inferior lateral groove shallow, bounded by simple inferior lateral ridges; inferior dorsal groove fairly long and broad; ventral, superior lateral and superior dorsal grooves each with two secondary grooves and ridges on each side. Ciliated band thickened on the secondary ridges. Apical organ in a slight depression between raised upper ends of praeoral and postoral fields. Mid-ventral postoral ridge of medium height and width. Anal field rather shallow; no secondary circumanal ring visible.

Proboscis-coelom weakly developed, narrow, transparent, with single, left pore. No trunk- or collar-coelom present. Stomach cylindrical or pear-shaped, projecting into the conical hind-gut.

Taken in the fine silk tow-net at Station 40 (3 miles East of Low Isles, 6th February, 1929, 3.50 p.m.).

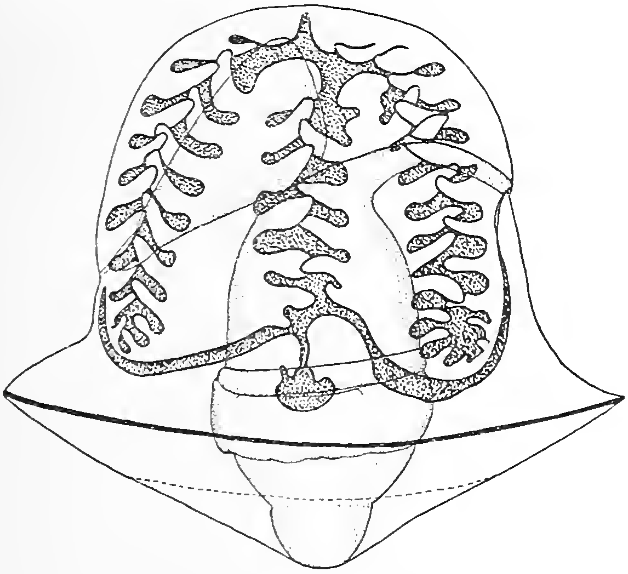
These are perhaps nearest to *T. yongei*, or may be an earlier stage of one of the larvae with lobate tentacles described below (pp. 55–62).

A Tornaria, $\frac{3}{4}$ mm. high, from Station 37, is very similar to these, but with the secondary ridges smaller, represented by the formula V. 2, 0 ; L. 2 or 3, 2 or 3 ; D. 0–1, 1. In the anal field is a broad ring of granular tissue like that forming the ciliated bands and their thickenings ; similar tissue surrounds the anus. This is reminiscent of the anal field of *T. russelli*, of which this may possibly be an early stage, before the forking of the primary dorso-lateral and ventro-lateral ridges has taken place.

6. *Tornaria setoensis*, Miyashita (Text-fig. 8).

Miyashita, 1925.* Stiasny, 1928, p. 73, figs. 5–7.

Below is description of an advanced Krohn-stage of a larva of this species :
Height $2\frac{1}{2}$ mm. ; diameter $2\frac{3}{4}$ mm.



TEXT-FIG. 8.—*Tornaria setoensis*. Lateral view. (× 30.)

Upper part of body bell-shaped, with flat apical region ; anal field an inverted cone with axis less than $\frac{1}{3}$ total height. Grooves deep, with overhanging edges, narrower than the ridges. Praeoral field anchor-shaped.

Oral arch narrow, high. Inferior lateral grooves flask-shaped, with a pair of outturned processes on the inferior lateral ridges. Inferior dorsal grooves narrow, turned upwards near mid-dorsal line, where they leave a narrow isthmus. Tentacles lobate, overlapping, free for more than half their length, the upper with ends turned upwards, not extending round upper ends of ridges ; tentacle formula, V. 11 or 12, 9 or 10 ; L. 5 or 6, 5 or 6 ; D. 8 or 9, 9 or 10. Mid-dorsal and praeoral mid-ventral ridges presenting parallel edges near apex, at which they are continuous ; apex not invaginated ; no eyespots discerned. Ventral belt nearly horizontal. Main ciliated ring irregularly wavy (simplified in figure). Secondary circumanal ring probably present, but invisible for most of its length.

* For the reference to this paper, which I have not seen, I am indebted to Stiasny's paper (*loc. cit.*).

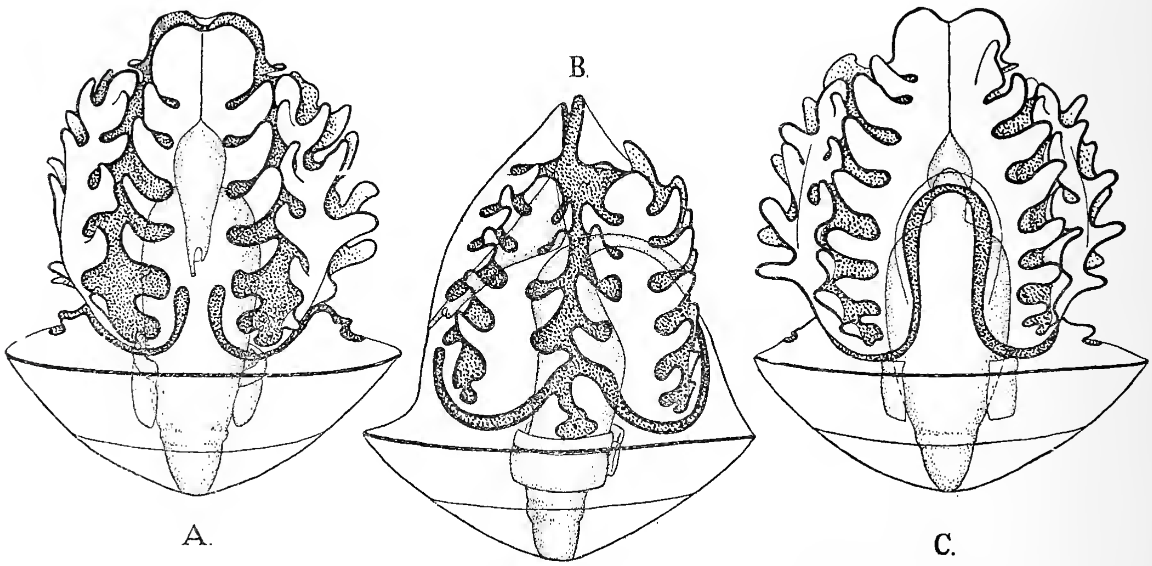
Proboscis-coelom large, with a single, left pore. Paired trunk- and collar-coeloms present, distinct but adjacent, transparent, close to gut, somewhat rounded, but not cylindrical.

A single specimen, from Station 19 (16° 20′ S., 146° 3′ E., outside Trinity Opening), taken 20th October, 1928, at 1 p.m., with the 1 metre coarse silk tow-net (vertical haul, 180 metres of wire out).

This Tornaria is considered to be specifically identical with *T. setoensis*, with which it shows a striking agreement in number of lobate tentacles,* shape of inferior lateral grooves and ridges and of the postoral ventral ridge, flatness of apical pole, etc. Certain differences suggest that this is a more advanced stage than that figured by Stiasny; the body-wall is semi-opaque; the proboscis- and collar-coeloms are larger; the diameter of the ciliated ring is relatively greater; the lobate tentacles are rather flabby, and meet or even overlap across the grooves. The slightly smaller size of the Barrier Reef specimen may be due to the shrinkage characteristic of the regressive phase of larval development.

7. *Tornaria cairnsiensis*, sp. n. (Text-figs. 9–11).

A larva with lobate tentacles.
Krohn-stage (Text-fig. 9).
Maximum height 2 mm.



Text-fig. 9.—*Tornaria cairnsiensis*. Holotype. Dorsal, right lateral and ventral views. (× 30.)

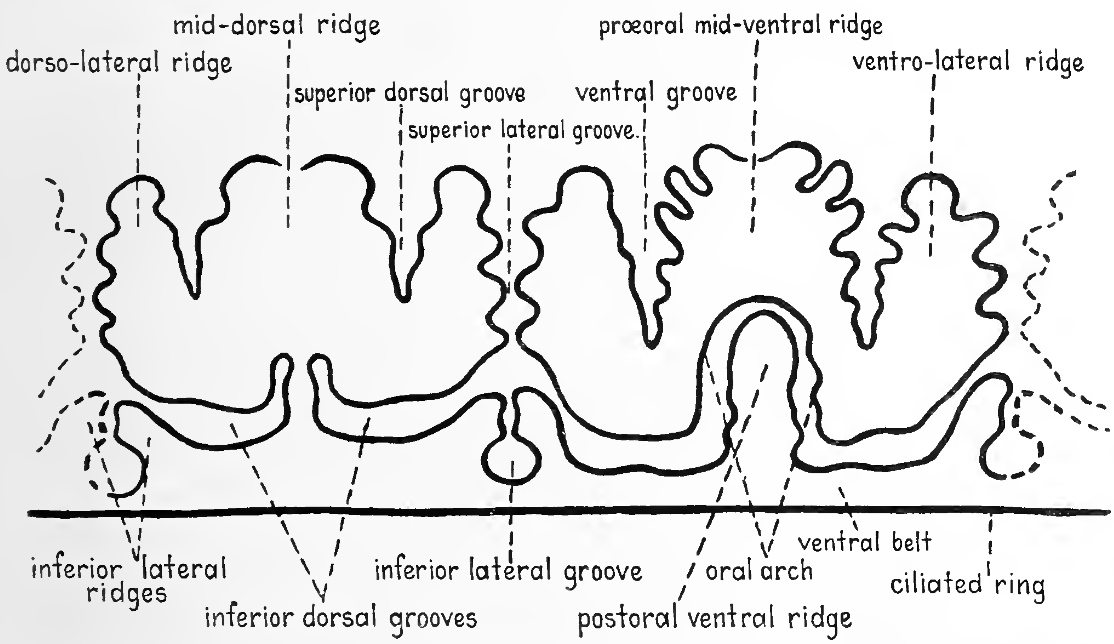
Shape a double cone; height greater than diameter of ciliated ring; axis of anal field about $\frac{1}{3}$ total height in later Krohn-stage, less in younger larvae. Praeoral field anchor-shaped.

Grooves of oral field about as wide as the ridges. Oral arch rather high and narrow. Inferior lateral grooves flask-shaped, bounded by large inferior lateral ridges, of which

* It is difficult to understand why Stiasny, in his diagram (*loc. cit.*, p. 74, fig. 7), shows the tentacles continued round the tops of the ridges, whereas his drawings show the ridges ending, as here, in a lobe as big as two tentacles, or why the number of tentacles bordering the superior lateral groove is greater in his diagram than in his drawings.

the ventral is usually larger; a pair of blunt processes at neck of flask. Inferior dorsal grooves long, narrow, curved upwards dorsally, with a narrow isthmus between them. Tentacles lobate, with ends turned upwards and overlapping, not continued round upper ends of ridges; V. 6–8, 6; L. 4, 4; D. 5 or 6, 5 or 6. Mid-dorsal ridge ending above in a broad lobe, which meets a similar, larger, ventral lobe, the two being reared up against each other so that the apical organ is slightly invaginated. Apical organ with a pair of eye-spots. Ventral belt of postoral field inclined at a small angle to the horizontal plane; greatest diameter of larva at ciliated ring. A secondary, transparent, circumanal ring, usually visible, mid-way between this and anus.

Proboscis-coelom with a single, left pore. Paired trunk- and collar-coeloms present, close to stomach; collar-coelom narrow, attached to anterior border of trunk-coelom. Oesophagus slightly curved; stomach ovoid; with narrow end projecting into hind-gut.



TEXT-FIG. 10.—*Tornaria cairnsiensis.* Projection of course of ciliated bands in a specimen $\frac{3}{4}$ mm. high. Secondary circumanal ring omitted.

Described from twelve specimens, $1\frac{1}{2}$ to 2 mm. high, from Stations 37 and 39, 3 miles East of Low Isles, 14th and 30th January (one in the fine, three in the coarse silk net, and two in the stramin net, St. 37; the rest in the stramin net, St. 39). These are at the height of larval development and are well preserved and transparent, forming some of the most beautiful objects of the plankton.

In addition, earlier stages are represented by:

(*a*) A single specimen (Text-fig. 11), $\frac{7}{8} \times \frac{3}{4}$ mm., taken in the coarse silk net at Station 38 (21st January, same locality).

(*b*) Four specimens, $1\frac{1}{4}$ to $1\frac{3}{8}$ mm. high, from the stramin net at Station 39.

(*c*) Thirty-eight specimens, $\frac{3}{4}$ to $1\frac{1}{2}$ mm. high, taken in the coarse silk net at Station 39.

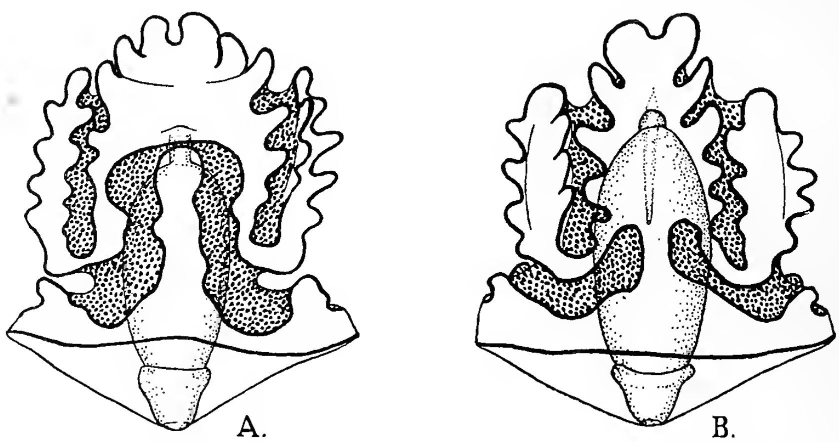
(*d*) A single specimen, 1 mm. high, taken in the coarse silk net at Station 52 (6th April, 1929, same locality).

One specimen, $1\frac{1}{4}$ mm. high, from Station 37, and two, about 1 mm. high, from Station 39, taken in the coarse silk net appear to be in an early regressive stage.

From this material five stages may be described.

(i) Height $\frac{3}{4}$ mm., diameter less than height. Transparent. First-formed parts of oral field wide; ventral and superior dorsal grooves short; "tentacles" short, few, in process of formation, those of superior lateral groove in advance of the others. Presence of secondary circumanal ring doubtful. Proboscis-coelom slender, transparent; no paired coelom. Represented by a single specimen from St. 39 (Text-fig. 10).

(ii) Height less than 1 mm.; diameter less than height. Transparent. Grooves of oral field wide; ventral and superior dorsal grooves fully formed; "tentacles" short, four on each side of superior lateral groove, those on ventral and superior dorsal grooves few, in process of development. Secondary circumanal ring present or absent. Proboscis-coelom a narrow, transparent tube, with pore. No paired coelomic sacs. Represented by the specimen from St. 38 (Text-fig. 11), and a few, less well preserved, from St. 39.



TEXT-FIG. 11.—*Tornaria cairnsiensis*. Ventral and dorsal views of a specimen $\frac{7}{8}$ mm. high. ($\times 60$.)

(iii) Height 1 to $1\frac{1}{2}$ mm.; diameter less than height. Transparent. Grooves of oral field narrow; tentacle-formula V. 5–6, 4–5; L. 4, 4; D. 3–5, 5; inferior lateral ridge with rudiment of tentacle-like process. Secondary circumanal ring usually visible. Proboscis-coelom rounded, transparent; paired trunk-coelom and usually also collar-coelom present, small, transparent, wafer-like. Anal field conical. Several specimens from St. 37, 39 and 52.

(iv) Height $1\frac{1}{2}$ to 2 mm.; diameter less than height. Transparent. Tentacles well formed, firm; V. 6–8, 6; L. 4, 4; D. 5 or 6, 5 or 6; inferior lateral ridge with tentacle-like process. Secondary circumanal ring usually visible. Proboscis-coelom somewhat opaque and muscular; trunk and collar coeloms transparent, larger than in previous stage, but still flattened in a plane parallel to gut-wall. Anal field with sides more convex, almost a sector of a sphere; wall of anal field with tendency to be more opaque than rest of body-wall. Larval development at its climax. Represented by the eleven specimens described (Text-fig. 9).

(v) Height from a little less than 1 mm. to $1\frac{1}{4}$ mm.: diameter nearly or quite equal to height. Semi-opaque. Anterior, tentacle-bearing part of larva shrunken, somewhat depressed (but apical organ still invaginated between adpressed upper ends of praeoral and postoral fields): tentacles with tendency to become flabby; tentacle formula as stage (iv), but in one specimen apparently only three on either side of superior lateral groove. Inferior lateral ridge with out-turned process. Secondary circumanal ring visible in one specimen. Anal field shaped like a flat-rimmed bowl. Proboscis-coelom opaque; trunk- and collar-coeloms adjacent, curved cylinders, with semi-opaque walls. Early regressive ("Krohn-Spengel") stage. Represented by three specimens, none of which is sufficiently perfect or well preserved to be figured, from Stations 37 and 39 (coarse silk net).

The first two of these stages correspond most nearly to the Metschnikoff-stage of Stiasny-Wijnhoff and Stiasny, but differ from it in the presence of secondary ridges or lobate tentacles. The third and fourth are early and late Krohn-stages, but differ from the typical Krohn-stage in the early development of the collar-coelom. The fifth stage differs from a typical Spengel-stage in the retention of the lobate tentacles and relative transparency of the body-wall.

The youngest stage described here is very similar to *T. wynhoffi*, Stiasny (1928, p. 76, figs. 8 and 9), from Seto, near Osaka, Japan. The chief differences are the broader oral field and horizontal upper lip of *T. wynhoffi*; these may simply indicate an earlier stage of development, and it is possible that the two species are identical. Another possibility is that *T. wynhoffi* is a young *T. setoensis*, which must be very similar to *T. cairnsiensis* in the earlier stages. The size of *T. wynhoffi* was unknown to Stiasny.

T. cairnsiensis differs from *T. setoensis* in the shape of the apical region and number of lobate tentacles. The constant presence of four of these on either side of the superior lateral groove in specimens of 1 to 2 mm. is very striking, and it is unlikely that *T. cairnsiensis* ever attains the size of known specimens of *T. setoensis*.

Two other Tornarias which come up for comparison are *T. ritteri*, Spengel, from the Californian coast (Ritter, 1894: Ritter and Davis, 1904), and *T. weldoni*, Stiasny, from the Bahamas (Stiasny, 1921*a*; the specimen described by Morgan in 1894 does not compare so closely). These both have lobate tentacles and a convex anal field, with secondary circumanal ring. The numbers of tentacles correspond very closely, but *T. ritteri* appears to have fewer ("about three") on each side of the superior lateral groove. In the diagram of *T. weldoni* (Stiasny, 1921*a*, p. 4, fig. 1) there are four or five tentacles in this position, but the figures (pl. i, figs. 2–5) show only two or three, less well-formed than those of the dorsal groove.

T. ritteri differs from *T. cairnsiensis* in the following characters:

(i) Oral arch wider and lower.
(ii) Ventral belt apparently wider and steeper.
(iii) Dorso- and ventro-lateral ridges shorter.
(iv) Lobate tentacles shorter, not meeting across grooves.

T. weldoni differs from *T. cairnsiensis* in the following characters:

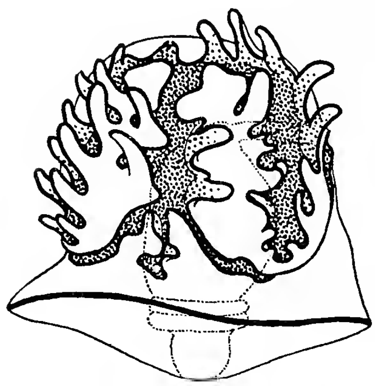
(i) Excess of diameter over height.
(ii) Absence of tentacle-like processes on inferior lateral grooves.
(iii) Collar-coelom separate from trunk-coelom.

8. *Tornaria* sp., near *T. cairnsiensis* (Text-fig. 12).

Krohn-Spengel stage of a larva with lobate tentacles.

Height 1 mm.; diameter $1\frac{1}{6}$ mm.

Upper part of body dome-shaped, with flat apical pole; axis of anal field about $\frac{1}{4}$ total height. Body-wall somewhat opaque. Oral arch high, narrow. Grooves of oral field narrow. Inferior lateral grooves flask-shaped, with prominent inferior lateral ridges, each with a blunt, tentacle-like process at neck of flask. Tentacles of a rather slender lobate type, projecting outwards; two tentacles and the rudiment of a third (indicated by " $\frac{1}{2}$ " in the formula) on superior lateral groove; tentacle formula V. 8, 6; L. $2\frac{1}{2}$, $2\frac{1}{2}$; D. 5, 6. Structure of apical organ not visible. No secondary ciliated ring detected.



TEXT-FIG. 12.—*Tornaria* sp. from Station 19. Right lateral view. (×45.)

Two pairs of cylindrical coelomic sacs close to gut, the collar-coelom adjacent to the trunk-coelom.

A single specimen from Station 19, taken in the same net as *T. setoensis*.

This Tornaria differs from the early regressive stage of *T. cairnsiensis* in the flatness of the apical pole, shallower anal field, and the presence of only two or three tentacles on either side of the superior lateral groove, although these are firm, and show no signs of degeneration. The poorness of the material of the corresponding stage of *T. cairnsiensis* makes a decision as to the specific distinctness of this specimen impossible at present.

It resembles *T. setoensis* in shape, as well as in time and place of capture, but the two are at almost the same developmental stage, and the difference in size and in number of tentacles seems too great for specific identity.

9. *Tornaria* sp. from Station 20 (Text-fig. 13).

Late Krohn-stage of a larva with lobate tentacles.

Height $1\frac{1}{4}$ mm.

Shape a double cone. Diameter nearly equal to height; anal field convex, with axis a little less than $\frac{1}{3}$ total height. Body-wall translucent.

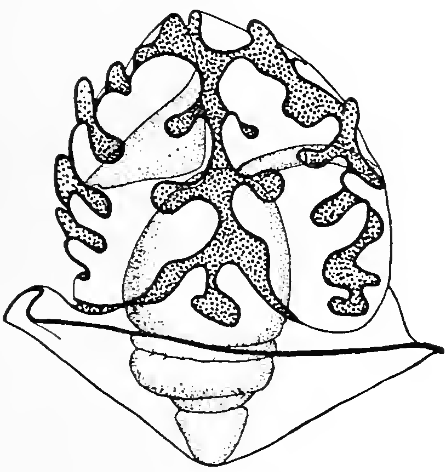
Inferior lateral ridges almost rectangular, without tentacle-like processes; inferior lateral groove roughly flask-shaped. Well-developed inferior dorsal grooves. Praeoral field anchor-shaped. Tentacles lobate, rather short; V. 6, 4; L. 2 or $2\frac{1}{2}$, 2; D. 4, 4,

Apical organ slightly invaginated ; upper ends of prae- and postoral fields meeting at an obtuse angle. No secondary circumanal ring.

Proboscis-coelom with a single, left pore. Paried trunk-coelom present, close to gut, with adjacent collar-coelom.

A single specimen from Station 20 (16° 19′ S., 146° 7′ E., outside Trinity Opening), taken 20th October, 1928, at 11.35 a.m., in the Nansen vertical net, with 250 metres of wire out.

This Tornaria differs from specimens of *T. cairnsiensis* of the same size in the apparent absence of a secondary circumanal ring, and in having only two tentacles, or two and a small rudiment, on either side of the superior lateral groove.



TEXT-FIG. 13.—*Tornaria* sp. from Station 20. Right lateral view. (× 45.)

It differs from the small Tornaria with lobate tentacles from Station 19 (Text-fig. 12) in general shape and in having shorter, thicker tentacles, fewer on the dorsal and ventral grooves, and simpler inferior lateral ridges. It is perhaps nearest to *T. weldoni*, Stiasny, 1921*a*, in which the chief difference is the presence of a secondary circumanal ring at a corresponding stage.

10. *Regressive Stage* (*Spengel Stage*) *of a Larva with Lobate Tentacles* (Text-fig. 14).

Height $1\frac{1}{2}$ mm. ; diameter $1\frac{3}{4}$ mm.

Diameter of ciliated ring much greater than that of any other part. Upper part of larva swollen, depressed, with flattened, invaginated apical pole. Anal field shaped like a flat-rimmed bowl, its axis comprising $\frac{2}{5}$ total height of larva.

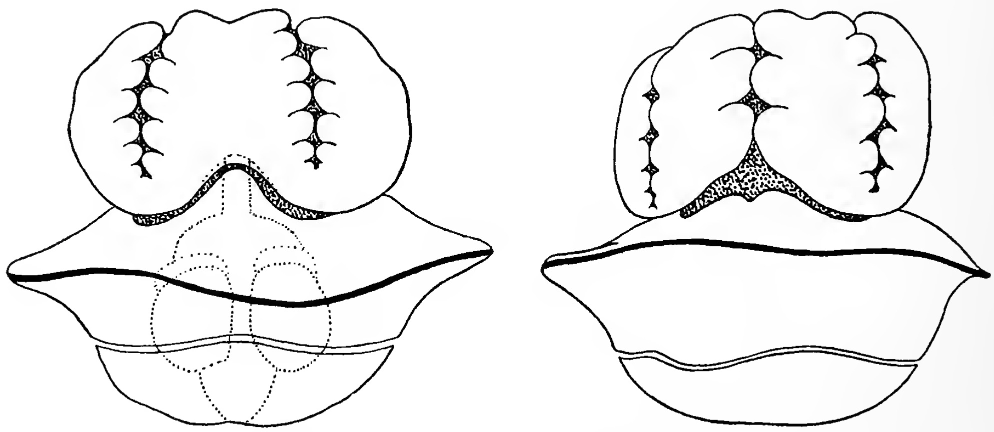
Body-wall opaque. Grooves of oral field narrow, overhung by the swollen ridges ; no praeoral and postoral ciliated bands visible. Praeoral field of anchor-shaped type. Oral arch low, enclosing a wide angle. Inferior lateral groove almost imperceptible, bounded by low eminences. Inferior dorsal groove long and deep. Tentacles represented by blunt, rounded secondary ridges, separated by narrow secondary grooves ; tentacle formula V. 6 or 7, 5 or 6 ; L. 2, 2 ; D. 4 or 5, 6. Anal field with secondary circumanal ring midway between anus and main ciliated ring.

Proboscis-coelom with a single left pore. Paired trunk-coelom close to gut, with narrow collar-coelom attached to it in front.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E.), taken 20th October, 1928, at 11.42 a.m., in the Nansen vertical net (180 metres of wire out).

The body-wall is broken along the line of the secondary, circumanal ring, and only through this break could the internal organization be made out.

In number and proportions of the secondary ridges (or lobate tentacles) this most resembles the Tornaria from Station 20 (Text-fig. 13), which, however, appears to lack a secondary circumanal ring. If, as seems probable, it is a later stage of this, or some other larva with lobate tentacles, it is interesting to note that ridges, representing the "tentacles,"



TEXT-FIG. 14.– *Tornaria* in regressive stage. Ventral and lateral views. (× 40.)

persist when there is no longer any trace of praeoral and postoral ciliated bands, at least in surface view. In the very similar *Tornaria weldoni*, Stiasny, however, it appears that the ridges vanish by the simplification of the still visible ciliated band (*cf.* Stiasny, 1921*a*, pl. i, fig. 5).

Association of Larvae with Lobate Tentacles with Adults.

Larvae with lobate tentacles are considered by Stiasny to belong to *Balanoglossus* or *Glossobalanus*, since they are not very different from the Tornaria of *B. clavigerus*, the only Enteropneust with indirect development whose life-history has been worked out. *T. weldoni* was found where *B. biminiensis* is the common Enteropneust, and it is probable that one of the species here described belongs to the closely related *B. carnosus*. *B. carnosus* is a giant species, and this fact suggests that the largest Tornaria in question, *T. setoensis*, may belong to it. This suggestion has already been made by Stiasny (1928), in view of the association of the two in Japanese waters. Another possibility is that *T. cairnsiensis* may belong to *B. carnosus*, (see above p. 48). Speculations as to the identity of these Tornarias are, however, of little use until more is known of the Enteropneust fauna of the region, and it is very desirable that more life-histories should be worked out.

11. ? *T. delsmanni*, Stiasny-Wijnhoff and Stiasny.

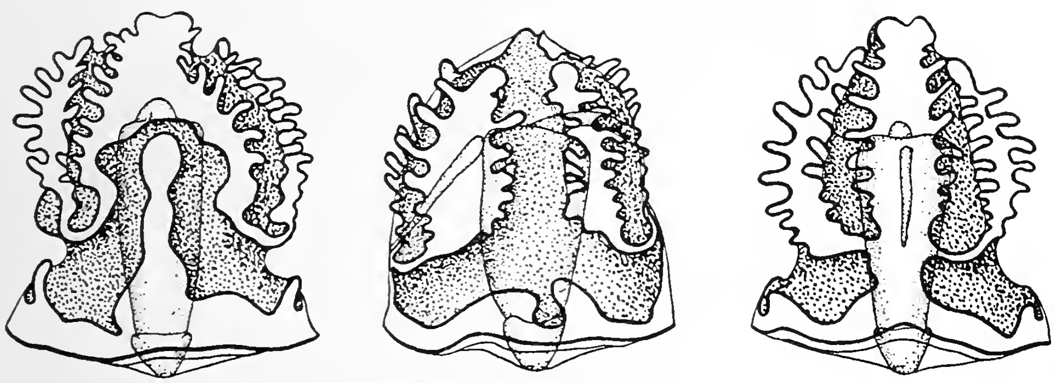
"Die Tornaria von Madoera" (*T. delsmanni*), Stiasny-Wijnhoff and Stiasny, 1927, p. 163, figs. 78, 79.

Three stages are represented in this collection, each by a single specimen :

(i) Metschnikoff-Krohn stage (Text-fig. 15). Height $1\frac{1}{4}$ mm. ; diameter 1 mm.

Bell-shaped, with almost flat anal field : diameter of ciliated ring but little greater than that of anterior part of larva. Grooves of oral field broad and shallow. Praeoral field and anterior part of postoral field with very narrow bridges between their median and lateral portions.

Oral arch rather broad. Postoral mid-ventral ridge high, narrow. Inferior lateral grooves present, bounded by simple ridges, that on the ventral side the larger. Inferior



TEXT-FIG. 15.— ? *Tornaria delsmanni*. Metschnikoff-Krohn stage (× 40.) The inner surfaces of the tentacles, although strictly part of the oral field, are left white here and in Text-figs. 16 and 17.

dorsal groove broad, not expanded dorsally. Tentacles narrow, rather short, the lower rudimentary ; V. 8 or 9, 7 or 8 ; L. 7 or 8, 7 or 8 ; D. 7, 7 or 8. Ciliated bands ending at apical organ, which is but little invaginated. Ventral belt of postoral field narrow, almost vertical. A secondary, transparent, circumanal ring close to main ciliated ring.

Proboscis-coelom a narrow strand of tissue, with a single pore near mid-dorsal line. No paired coelom. Oesophagus short, almost horizontal ; stomach cylindrical, projecting into a small, conical hind-gut.

A single specimen, from Station 38 (3 miles East of Low Isles, 21st January, 1929), taken at 10.20 a.m. in the coarse silk net.

(ii) Krohn-stage (Text-fig. 16). Height nearly 3 mm. ; diameter $2\frac{3}{4}$ mm.

Shape a double cone ; anal field rather shallow, its axis about $\frac{1}{6}$ total height. Praeoral field and anterior part of postoral field anchor-shaped.

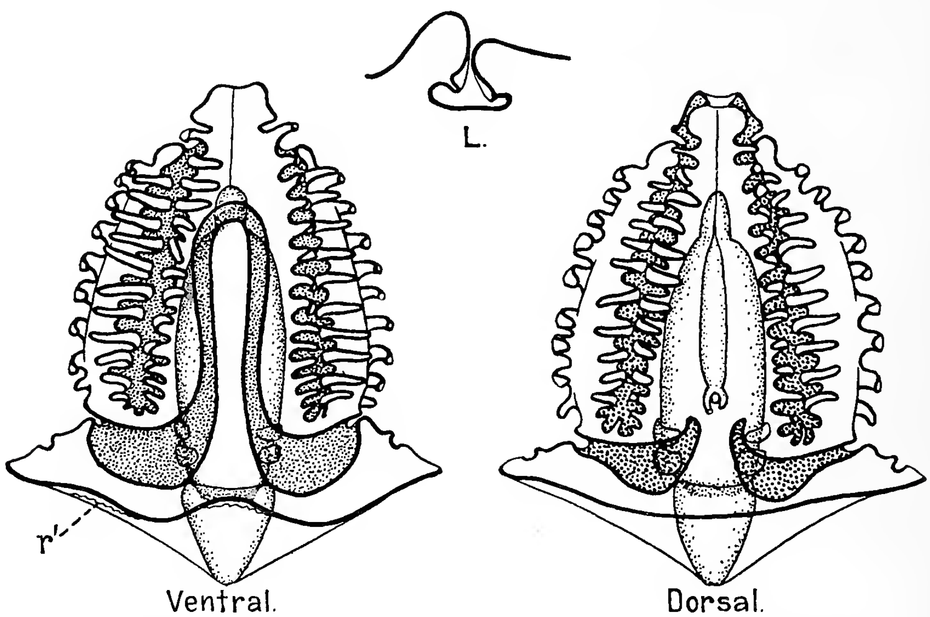
Oral arch and postoral mid-ventral ridge high, narrow. Inferior lateral grooves flask-shaped, with a short, tentacle-like process on each of the inferior lateral ridges, of which the ventral is higher than the dorsal. Inferior dorsal groove deep, somewhat expanded dorsally. Tentacles long, narrow, turned outwards and usually reflexed over ridges, continuous round lower ends of grooves, but not round upper ends of ridges. Tentacle at base of each dorsal groove longer than those next to it ; V. 13–15, 10 or 11 ;

L. 9, 9 ; D. 11, 12–14. Ciliated bands ending at apical organ ; upper ends of praeoral and postoral fields meeting at an acute angle, so that apex is visible from dorsal side only. A secondary circumanal ring close to main ciliated ring.

Proboscis-coelom narrow, with two short ducts, only the left of which opens by a pore. Stomach cylindrical, not wider than hind-gut, which is unusually long. Paired trunk- and collar-coeloms present, close to gut, separate from each other.

A single specimen, from Station 37 (3 miles East of Low Isles, 14th January, 1929), taken at 9.40 a.m. in the fine silk tow-net.

(iii) Spengel stage (Text-fig. 17). A fragment, consisting of the left postero-dorsal portion of the larva. This differs from the complete specimen in the greater development



TEXT-FIG. 16.—? *Tornaria delsmanni.* Krohn stage. (× *ca.* 22.) *L.*, inferior lateral ridges, more highly magnified ; *r'.*, secondary, circumanal ring.

of the paired coelomic sacs, the broad, rather opaque proboscis-coelom, and the apparent absence of a secondary circumanal ring. The radius of the shallow anal field is about 1 mm. ; the diameter was therefore probably not greater than that of the Krohn-stage. Eleven tentacles are present on one side of the most nearly complete dorsal groove. At the lower end of the superior lateral groove is an oval, cushion-like thickening of the epidermis, with a groove along its longer, dorso-ventral axis (Text-fig. 17, *ep. o.*). This is in the wrong position for a collar-pore or gill-pore, and in any case is quite unconnected with oesophagus or collar-coelom. The tissue around it is well preserved and it has the appearance of a normal structure.

Taken at Station 35 (3 miles East of Low Isles, 27th December, 1928), at 10.18 a.m. in the stramin net.

This fragment is probably of the same species as the other two tentaculate larvae, but no stress is laid on its identification as such.

In comparing the Barrier Reef specimens with their nearest known relatives only the Krohn-stage can be used, since this stage alone was described in *T. sunieri* (Stiasny,

1921*b*, p. 101, figs. 1–4). The Barrier Reef specimen differs from *T. sunieri*, and agrees with *T. delsmanni* in size and proportions, in the greater number of tentacles, in the presence of inferior lateral ridges, each with a short tentacle-like process, and in the shape of the inferior dorsal groove. The proboscis-coelom in T. *sunieri* is broad and rounded; it is not described in the corresponding stage of *T. delsmanni*. The apparent absence of a secondary circumanal ring in *T. delsmanni* cannot be stressed, since the material was admittedly not well preserved.

These specimens are therefore referred somewhat doubtfully to *T. delsmanni*. In any case they increase the probability of the distinctness of *T. delsmanni* and *T. sunieri*, of which Stiasny-Wijnhoff and Stiasny were not convinced.

TEXT-FIG. 17.—Fragment of a tentaculate larva in Spengel stage. (× 40.) *ep.o.*, lateral epithelial organ.

No tentaculate larva with coelom close to gut has been traced to its adult. Stiasny-Wijnhoff and Stiasny (1927, p. 189) suggest that it may be the type characteristic of the genus *Spengelia*, of which six species have been described from the Indo-Pacific region.

12. *Tornaria* sp. ? (Text-fig. 18).

Regressive stage, probably of a tentaculate larva.

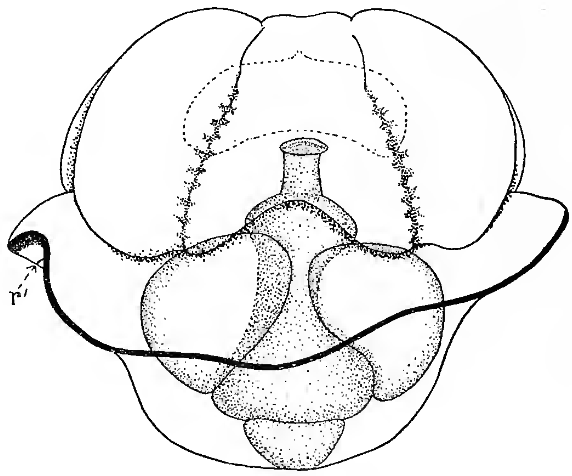
Height 2 mm.; diameter $2\frac{1}{2}$ mm.

Body-wall almost opaque. Upper part of larva depressed, with apical pole invaginated; axis of anal field about $\frac{1}{2}$ total height; greatest diameter at level of ciliated ring.

Grooves of oral field narrow, overhung by the swollen ridges, on the borders of which no ciliated bands are visible. Praeoral field of anchor-shaped type. Oral arch low, wide. Inferior lateral groove a slight radial depression. Inferior dorsal groove, if present, merged in the general constriction of this zone. Tentacles reduced to almost imperceptible, low bosses; approximate tentacle formula V. 9 to 11, 9 to 11; L. ? 4, ? 4; D. 8 to 10, 8 to 10. Circular ciliated band broad. A secondary, transparent circumanal ring within this, distant from it only a little more than width of ciliated band.

Proboscis-coelom well developed; shape doubtful. A pair of large coelomic pouches close to gut. Collar-coelom ?. Stomach large, constricted by the coelomic pouches; hind-gut small, conical.

A single specimen from Station 19 (16° 20′ S., 146° 3′ E.), taken 20th October, 1928, at 11.42 a.m. in the Nansen vertical net (180 metres of wire out).



TEXT-FIG. 18.—*Tornaria* in regressive stage. Ventral view. (× 30.) *r′*. Secondary circumanal ring.

It is impossible to relate this larva with certainty to any other. The position of the coelom and of the circumanal transparent ring suggest the tentaculate larvae referred to *T. delsmanni*, but the shape of the anal field and relative size of the diameter of the main ciliated ring are very different. The distance between the developmental stages represented makes comparison difficult, and if the tentaculate fragment from Station 35 is specifically identical with the younger specimens, the older larva is almost certainly distinct.

REFERENCES.

BOULENGER, G. A. 1910. Les Batraciens. Encyclopédie Scientifique, Paris, pp. 1–305.

—— and ANNANDALE, N. 1918. Rec. Ind. Mus. XV, pp. 51–67.

BOURNE, G. C. 1889. On a Tornaria found in British Seas. J. Marine Biol. Ass. (2) I, pp. 63–68, pls. vii, viii.

CALMAN, W. T. 1909. Crustacea, in Lankester's Treatise on Zoology, VII (3), pp. 1–346.

DAKIN, W. J. 1916. A New Species of Enteropneusta, *Ptychodera pelsarti*, from the Abrolhos Islands. J. Linn. Soc. Zool. London, XXXIII, pp. 85–100, pls. i, ii.

ESCHSCHOLTZ, FR. 1825. Oken's Isis, p. 740, pl. v, fig. 8.

GIARD, A. 1891. Sur le bourgeonnement des larves d'*Astellium spongiforme* Gd. et sur la Poecilogonie chez les Ascidies composées. Comptes Rendus de l'Ac. Sci., Paris, CXII, pp. 301–304.

—— 1892. Nouvelles Remarques sur la Poecilogonie. Comptes Rendus de l'Ac. Sci., Paris, CXIV, pp. 1549–1552.

GRAVIER, C. 1905. Sur le *Ptychodera erythraea* Spengel. Bull. Soc. Philom. Paris (sér. 2), VII, pp. 69–74, 4 figs.

HILL, J. P. 1897. The Enteropneusta of Funafuti. Mem. Austral. Mus. III, pp. 203–210, pl. ix.

HORST, C. J. VAN DER. 1924. West-indische Enteropneusten. Bijdr. tot de Dierkunde, XXIII, pp. 33–60, pls. iv–vii.

—— 1930. Papers from Dr. Mortensen's Pacific Expedition 1914–16: LI, Observations on some Enteropneusta. Vidensk. Medd. naturh. Foren, Kjob. LXXXVII, pp. 135–200, figs. 1–64.

KLUNZINGER, C. B. 1902. Über *Ptychodera erythraea* Spengel aus dem Rothen Meere. Verh. Deutsch. Zool. Ges. XII, pp. 195–202, figs. 1–4.

MACBRIDE, E. W. 1920. Larvae of Echinoderma and Enteropneusta. British Antarctic ("Terra Nova") Exped. 1910, Nat. Hist. Rep., Zool. London, IV (3), pp. 83–94, pls. i, ii.

MASER, O. 1913. Über *Balanoglossus carnosus* (Willey) und eine ihm nahestehende, neue Art von Neucaledonien. Zool. Jahrb. Abt. Anat. XXXIII, pp. 361–430, pls. xxv–xxix.

MENON, K. R. 1903. Enteropneusta from Madras. Quart. J. Micr. Sci., London, XLVII, pp. 123–131, pl. x.

MIYASHITA, Y. 1925. Über Tornaria-Larven aus Japanischen Küste. Dobutsugaka Zasshi, Tokyo, XXXVII, No. 438. [Not seen. Quoted from Stiasny, 1928.]

MORGAN, T. H. 1894. The Development of *Balanoglossus*. J. Morph. IX, pp. 1–86, pls. i–vi.

PUNNETT, R. C. 1903. The Enteropneusta. In Gardiner, J. S., Fauna and Geog. Maldive and Laccadive Archipelagoes, II, pp. 631–680, pls. xxxvii–xlvi, Cambridge.

RITTER, W. E. 1894. On a new *Balanoglossus* Larva from the Coast of California, and its Possession of an Endostyle. Zool. Anz. XVII, pp. 24–30, figs. 1, 2.

—— and B. M. DAVIS. 1904. Studies on the Ecology, Morphology and Speciology of the Young of some Enteropneusta of Western North America. Univ. Calif. Publ. Zool. I (5), pp. 171–210, pls. xvii–xx.

SCHMARDA, L. K. 1871–2. Zoologie, I, p. 273 [Not seen. Quoted from Spengel, 1904*c*.]. 2nd edn. 1877, pp. 367–369, fig. 237.

SPENGEL, J. W. 1893. Fauna and Flora Neapel, XVIII, Enteropneusten, pp. xii, 756 [2], 36 pls. (col.), 1 map.

—— 1903. Neue Beiträge zur Kenntniss der Enteropneusten. 1. *Ptychodera flava* Eschscholtz, von Laysan. Zool. Jahrb. Abt. Anat. XVIII, pp. 271–326, pls. xxiv–xxix.

—— 1904*a*. Neue Beiträge . . . 2. *Ptychodera flava* von Funafuti. Zool. Jahrb. Abt. Syst. XX, pp. 1–18, pl. i, ii.

—— 1904*b*. Neue Beiträge . . . 4. *Ptychodera erythraea*. Zool. Jahrb. Abt. Syst. XX, pp. 413–428, figs. A, B.

—— 1904*c*. Eine wieder aufgefundene Enteropneusten-Art (*Balanoglossus tricollaris* Schmarda). Zool. Anz. XXVIII, pp. 52–54.

STIASNY, G. 1921*a*.* Über westindische Tornarien nebst einer Übersicht über die bisher bekannten tentaculaten Tornarien. Versl. gewone Akad. Amsterdam, XXIX (also in Proc. R. Acad. Amsterdam, XXIII, 1921, pp. 2–36, pls. i, ii, figs. 1–3).

—— 1921*b*. Eine neue Tornaria aus dem ostindischen Archipel (*Tornaria sunieri*). Zool. Meded. Leiden, VI, pp. 101–108, figs. 1–4.

—— 1922.* Die Tornarien-sammlung von Dr. Th. Mortensen. Vidensk. Medd. naturh. Foren. Kjob. LXXIII, pp. 123–137, figs. 1–9.

—— 1928. Tornarien von Japan. Zool. Jahrb. Abt. Syst. LVI, pp. 67–92, figs. 1–19.

STIASNY-WIJNHOFF, G., and STIASNY, G. 1926. Über Tornarientypen und ihre Beziehung zur Systematik der Enteropneusten. Zool. Anz. LXVIII, Leipzig, pp. 159–165, figs. 1–9.

—— 1927. Die Tornarien. Kritik der Beschreibungen und Vergleich sämtlicher bekannter Enteropneusten-Larven. Ergebn. Fortschr. der Zool. VII, Jena, pp. 38–208, figs. 1–78, 7 charts.

WILLEY, A. 1897. On *Ptychodera flava* Eschscholtz. Quart. J. Micr. Sci. London, XL, pp. 165–183, pl. 5.

——— 1899. Enteropneusta from the South Pacific, with Notes on West Indian Species. Willey, A., Zoological Results, Part III, pp. 223–334, pls. xxvi–xxxii.

* These dates are taken from the wrappers of parts of the respective periodicals. They are each a year later than those quoted by Stiasny-Wijnhoff and Stiasny (1927), which may perhaps be the dates when the papers were read. 1921*a* has been seen by me in 'Proc. R. Acad. Amsterdam' only.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 3

TUNICATA

BY

ANNA B. HASTINGS, M.A., PH.D.
Assistant Keeper in the Department of Zoology

WITH SEVENTEEN TEXT-FIGURES AND THREE PLATES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, W. 1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, S.W. 7
1931

Price Five Shillings

[*Issued 25th April, 1931*]

ADLARD & SON, LTD. 21, HART STREET W.C.

Made and printed in Great Britain.

TUNICATA

BY

ANNA B. HASTINGS, M.A., Ph.D.,
Assistant Keeper in the Department of Zoology.

WITH SEVENTEEN TEXT-FIGURES AND THREE PLATES.

The Tunicata form two ecological groups which coincide with important systematic divisions, the Ascidiacea being benthic, the Thaliacea and Appendicularia planktonic. It will be convenient to treat these groups separately.

ASCIDIACEA.

The value of the collections of the Barrier Reef Expedition is enhanced by the quantity of ecological observations accompanying them, which can be found in the general reports. They are also important as coming from one of the parts of the Australian coast whose Ascidian fauna is less well known, our knowledge depending chiefly on Herdman's Catalogue (1899), which needs revision. The Ascidians of the N.W. and S.W. coasts have recently been studied by Hartmeyer (1919), Hartmeyer and Michaelsen (1928) and Michaelsen (1930).

Geographical Distribution.

From its position at the N.E. corner of Australia, the fauna of the Great Barrier Reef might be expected to show affinities with the Malayan as well as the Australian fauna, and this intermediate position gives it some interest. Until more is known of the species described by Herdman (1882*b*, 1886, 1899) and Sluiter (1895, 1904, 1909), no exact account of the distribution of Tunicates in the Australian and Malayan regions can be given. It is worth noticing, however, that, of the 36 species of Ascidians in the collection, 21 were already known from the Australian coasts and 17 from Malaya. Hartmeyer and Michaelsen (1928, p. 257) also found a relationship between the Australian (W. Australian) tunicate fauna and that of Malaya.

There are only 7 species in the Barrier Reef collection that have not been found beyond the coasts of Australia, and several are widely distributed in the Indian Ocean, some

extending as far as Africa. Records of Australian species in the Atlantic are not numerous and are not generally very convincing. It seems probable, however, that some (*e.g. Ascidia sydneiensis*) really have this very wide distribution. The synonymy of the Tunicata is, however, still too uncertain for detailed discussion to be profitable.

Parasitic and Commensal Associates of the Ascidiacea.

Various parasitic and commensal animals were associated with the Ascidians. They will be included in the appropriate reports of the Barrier Reef Expedition. A list follows:

Lamellibranchs were embedded in the test of specimens of *Polycarpa cryptocarpa* (St. XIX) and *Cnemidocarpa irma* (St. XIX).

The specimen of *Polycarpa procera* (St. XXV) had a Gymnoblastic Hydroid growing on the inner surface of the branchial siphon.

Commensal Amphipods were found in the branchial sac of *Phallusia depressiuscula* (St. XIX), *Polycarpa pedata* (St. XVI) and *Cnemidocarpa irma* (St. XIX, XXII), and in the atrial siphon of *Polycarpa aurita* (St. XIX).

Decapoda natantia were living in the cloacal canals of *Sigillina deerrata* (St. XVII). Individuals belonging to the genus *Pontonia* were present in the branchial sac of *Phallusia depressiuscula* (St. VIII) and *Pyura momus* form *grandis* (St. XIX, XXII).

Parasitic Copepods of the family Notodelphyidae were found in the branchial sac of *Podoclavella meridionalis* (St. XXII) and of both specimens of *Phallusia depressiuscula* (St. VIII, XIX). Specimens of *Polycarpa cryptocarpa* (St. XIX) contained a parasitic Crustacean resembling *Sphaerothylacus polycarpae* Sluiter.

Zooxanthellae have been found in three species of Tunicate from the reef submitted to Dr. C. M. Yonge, namely *Trididemnum cyclops* (p. 89), *Didemnum voeltzkowi* (p. 97) and *Diplosoma virens* (p. 102). The algae are not all of the same kind.

Type-Specimens.

The Amsterdam Museum very kindly lent me type-specimens of the following species described by Sluiter: *Styela aurita*, *S. albopunctata*, *Ascidia limosa*, *Distoma deerratum*, *Polycitor coalitus*, *Didemnum reticulatum*, *D. jedanense*, *D. chartaceum*. They also arranged an exchange of specimens by which we now have examples of most of the species of Appendicularians found by the Siboga and slides of the compound Ascidians mentioned above.

Collecting Stations.

Ascidians were obtained by shore collecting at Batt Reef, Yonge Reef, Three Isles and Low Isles. They were obtained at the following places on Low Isles: A4, F9, between F11 and IR1, G3, IM1, RC, the Sand Flat, the Thalamita Flat, the Mangrove Swamp. The symbols refer to the map of Low Isles given in Dr. Stephenson's Report on the Ecology of the Reef, where particulars of all shore collecting stations will be found.

They were collected by dredge or trawl from the following stations:

II. 24.ii.28. Linden Bank, 28 fath., shell and sand, dredge 10 min. and 5 min.
VIII. 21.ii.29. $1\frac{1}{2}$ miles N.W. Low Isles, 11 fath., mud, Agassiz trawl, 30 min.
IX. 22.ii.29. Penguin Channel, 12–14 fath., clean pit with mud at sides, 6 dredges about 20 min. each.

XII. 24.ii.29. Penguin Channel, 10–15½ fath., rock and shell gravel, mud on edges of pit, 5 dredges about 30 min. each.
XVI. 9.iii.29. About ½ mile W. of N. Direction I., 20 fath., stony, 6 dredges 20–30 min. each.
XVII. 9.iii.29. About ¼ mile N. of N. Direction I., 19 fath., sand, thick *Halimeda*, 2 dredges 40 min. each.
XIX. 10.iii.29. About ½ mile N. Eagle I., 10 fath., shell gravel, rich *Halimeda*, 3 dredges, 20–30 min.
XXI. 11.iii.29. ½ mile N.W. Howick Is., 10 fath., mud and shell, Foraminifera, 2 dredges, 30 and 40 min.
XXII. 11.iii.29. To East of Snake Reef, 13½ fath., mud with Foraminifera and shells, 2 dredges ½ hour each.
XXIII. 12.iii.29. In lee of Turtle Isles, 8 fath., mud and shell, 3 dredges, 30–45 min.
XXV. 17.iii.29. In Papuan Pass, 20–25 fath., Foraminifera and coral fragments, series of dredgings, 2¼ hours in all.

Nomenclature.

The subdivisions of species have been called subspecies, variety or form according to the usage of their authors, and it is therefore probable that, in this paper, they have no uniform significance.

Species of Ascidians in the Collection.

Ptychobranchiata.

Pyuridae.
- *Pyura momus* form *grandis* (Heller).
- *Microcosmus helleri* Herdman.

Styelidae.
- *Cnemidocarpa irma* Hartmeyer.
- *Polycarpa aurata* (Quoy & Gaimard).
- *P. pedata* Herdman.
- *P. ovata* Pizon.
- *P. fungiformis* Herdman.
- *P. cryptocarpa* (Sluiter).
- *P. aurita* (Sluiter).
- *P. procera* (Sluiter).

Polyzoidae.
- *Chorizocarpa sydneyensis* (Herdman).

Botryllidae.
- *Botryllus gracilis* Michaelsen.
- *B. magnicoecus* (Hartmeyer).

Dictyobranchiata.

Ascidiidae.
- *Ascidia sydneiensis* Stimpson.
- *A. granosa* Sluiter.
- *Phallusia depressiuscula* (Heller).
- *P. julinea* Sluiter.

Krikobranchiata.

Clavelinidae (in the sense of Michaelsen, 1930).
- *Podoclavella meridionalis* Herdman.
- *P. molluccensis* Sluiter.
- *Eudistoma ovatum* (Herdman).
- *Sigillina decrrata* (Sluiter).

Didemnidae.
- *Trididemnum cyclops* Michaelsen.
- *T. savignii* (Herdman).
- *T. natalense* Michaelsen.
- *Leptoclinides reticulatus* (Sluiter).
- *L. lissus* sp. n.
- *Didemnum candidum* Savigny.
- *D. psamathodes* var. *skeati* (Sollas).
- *Didemnum voeltzkowi* Michaelsen.
- *D. chartaceum* Sluiter.
- *D. jedanense* Sluiter.
- *D.* (*Polysyncraton*) *magnetae* sp. n.
- *Diplosoma spongiforme* Giard. var. ? Michaelsen.
- *D. virens* (Hartmeyer).
- *Diplosomoides ostrearium* Michaelsen.

Polyclinidae.
- *Polyclinum macrophyllum* subsp. *phortax* Michaelsen.

Pyura momus form *grandis* (Heller).

Cynthia grandis Heller, 1878, p. 97, pl. v, fig. 26.
Pyura momus form *grandis* Hartmeyer & Michaelsen, 1928, p. 441 (synonymy).

Distribution.—E. and S.W. Australia.

Occurrence.—St. XVII (1 specimen), XIX (4 specimens), XXII (5 specimens).

All these specimens have the long processes of irregular shape and distribution on the rim of the anus characteristic of form *grandis*.

One of the specimens from St. XIX has 11 folds on each side of the branchial sac, the other has 12. The convolutions of the ciliated band on the dorsal tubercle are very complicated. The test is dark and rough.

The specimens from St. XVII and XXII are smaller, paler and smooth, but they have 10 or 11 folds on each side of the branchial sac, and their dorsal tubercles, though less complicated than those from St. XIX, are more so than that figured by Herdman (1882*b*, pl. xvii, fig. 9, *Cynthia complanata* = *P. momus* form *grandis*).

The specimens all show the chief characteristics of form *grandis*, and the differences among them may be due to age.

According to Hartmeyer and Michaelsen (1928, p. 440), form *grandis* is a southern cool-water form replaced in the warmer waters of North Australia by form *galei*. These specimens, however, come from the tropical seas of the Barrier Reef, and yet resemble *grandis* rather than *galei* in all points of contrast between these two forms.

Microcosmus helleri Herdman.

Microcosmus helleri Herdman, 1882*a*, p. 54; 1882*b*, p. 131, pl. xiv, figs. 1–4; Hartmeyer, 1919, p. 19, pl. i, figs. 6–9; Van Name, 1924, p. 31; Hartmeyer & Michaelsen, 1928, p. 397 (synonymy).

Distribution.—Cape Jaubert, Torres Straits, Malaya, E. Africa, Curaçao.

Occurrence.—St. XIX (5 specimens), XVI (1 specimen), IX (1 specimen).

These specimens agree very closely with the description of *M. helleri* given by Hartmeyer (1919). The number and arrangement of the longitudinal bars shows general, though not exact, agreement with Hartmeyer's table. The test is thickly covered with shell fragments, etc.

Cnemidocarpa irma Hartmeyer. (Text-fig. 1.)

Cnemidocarpa irma Hartmeyer, 1927, p. 168; Hartmeyer and Michaelsen, 1928, p. 388, figs. 40–42.

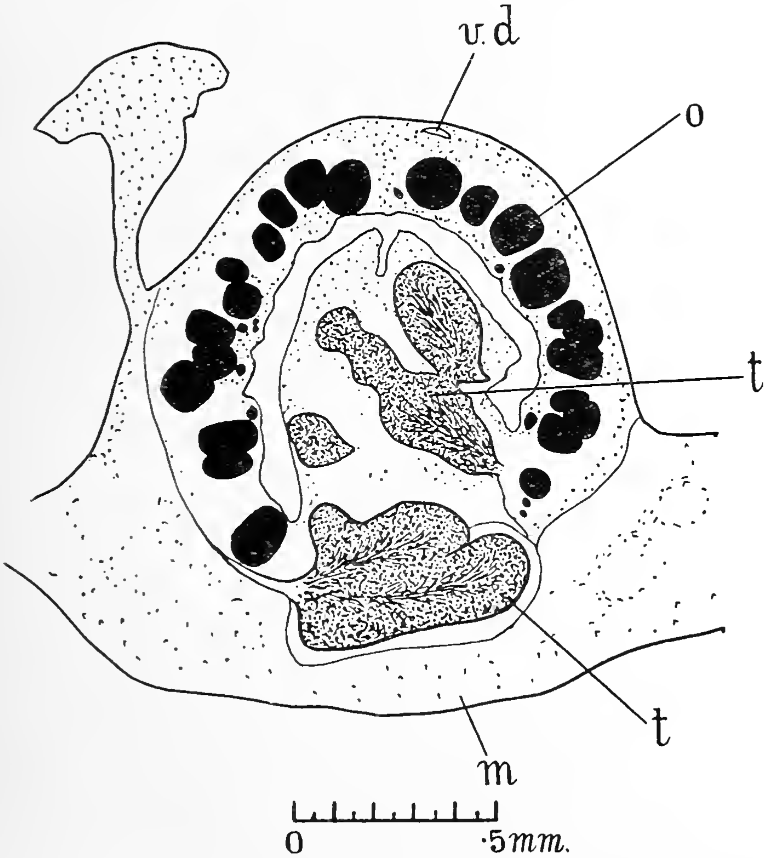
Distribution.—S.W. Australia.

Occurrence.—St. XIX (8 specimens), XXII (10 specimens).

The internal structure of these specimens falls within the range of variation attributed to this species by Hartmeyer, but they differ in their external form, for they appear to have been unattached and are thickly coated with coarse shell fragments, etc. Where the test is visible it corresponds to Hartmeyer's description. There is general agreement in the structure of the mantle, branchial sac and gut. The dorsal tubercle may be round or oval, with the tips of the arms meeting or with one curved in. As in Hartmeyer's specimens, there are three elongated gonads on the right side, one of which may be subdivided, and

two on the left. Hartmeyer's description does not make the arrangement of the ovarian and testicular tissue in the gonad clear, but it appears that the bulk of the testicular tissue is on the outside. If this is so the present specimens differ. In them the testis forms a core covered by a layer of ovarian tissue, only the vas deferens and the vasa efferentia running outside the ovary (Text-fig. 1). The eggs are arranged in an irregular single layer, and the testes from the two sides overlap each other (*cf.* Huntsman, 1913, p. 486).

There is one specimen from St. XIX in which the muscle-bundles in the mantle are rather less distinct and the longitudinal vessels are slightly more numerous. In this



TEXT-FIG. 1.*—*Cnemidocarpa irma* Hartmeyer. Transverse section of a gonad.

specimen the gonads are more numerous and shorter. There are 9 more or less oval gonads on one side, and 13 on the other, some groups having a common duct. In view of Hartmeyer's figure 42 this does not seem a sufficient reason for treating the specimen as distinct. Internally these gonads only differ from those of the other specimens in the more lobed testis.

* *Key to lettering of Text-figures.*—*a.*, anus ; *ab.*, abdomen of Crustacean ; *b.*, bud ; *c.*, cavity in test ; *c.f.*, ciliated funnel ; *cl.*, cloacal canal ; *cr.* Crustacean ; *f*, follicle ; *g*, gonad ; *i*, intestine ; i. 1, 1st section of the intestine, " nachtmagen " ; i. 2, 2nd section of the intestine, " drusenmagen " ; *l.*, lamina on transverse bar ; *m.*, mantle ; *o.*, eggs ; *o.d.*, oviduct ; *oe.*, œsophagus ; *p.*, peripharyngeal bands ; *r.*, rectum ; *s.*, stomach ; *s.v.*, stalked vesicles ; *t.*, testis ; *t.i.*, tissue surrounding intestine ; *t.t.*, thoracic tubercle ; *t.z.*, tentacular zone ; *v.*, vascular process ; *v.d.*, vas deferens.

Polycarpa aurata (Quoy & Gaimard).

Ascidia aurata Quoy & Gaimard, 1834, p. 604, pl. xci, fig. 3.
Polycarpa aurata Hartmeyer, 1919, p. 40 (synonymy, except *P. pedata* Herdman); Sluiter, 1919, p. 3.

Distribution.—Oceania, N.E. and E. Australia, Malaya, Indian Ocean.

Occurrence.—Outer Region, Batt Reef (4 specimens).

These specimens all have a rather smooth test and a hump beside the atrial aperture. The structure of the test and the internal anatomy agree well with the descriptions of Herdman (*P. sulcata*) and Hartmeyer. The collector notes their colour in life as yellow with purple streaks, the characteristic coloration figured by Quoy and Gaimard.

Polycarpa pedata Herdman.

Polycarpa pedata Herdman, 1882*a*, p. 71; 1882*b*, p. 180, pl. xxiv, figs. 1, 2; Van Name, 1918, p. 97, pl. xxiii, figs. 1–3 (synonymy).

Distribution.—E. Australia, Malaya.

Occurrence.—St. XVI (1 specimen).

This specimen, which has the external appearance of *P. pedata*, also differs from the Barrier Reef specimens of *P. aurata* in the internal characters noticed by Van Name, namely more numerous longitudinal vessels, short rectum, gonads longer and anastomosing. There is also a difference in the test, that of *P. pedata* being thinner and free from the knobbed ends of the vessels that give a spotted appearance to a cut surface of that of *P. aurata*. Examination of the type of *P. pedata* (B.M. 87.2.4.125) shows that it has a similar thin test, and so has the only other specimen available for comparison (B.M. 80.11.19.5 from Port Phillip Heads). It seems possible, therefore, that this is another point of distinction between these two forms.

Polycarpa ovata Pizon. (Plate I, figs. A and B.)

Polycarpa ovata Pizon, 1908, p. 211, pl. xi, figs. 15–20; Van Name, 1918, p. 101, pl. xxxi, fig. 31, text-figs. 53–55.

Distribution.—Amboina, Philippines.

Occurrence.—St. XVI (1 specimen).

This specimen agrees fairly well with the descriptions of Pizon and Van Name. Externally (Plate I, fig. A) it is smoother and it is attached by a cluster of rooting processes. The dorsal tubercle has the tip of its right arm curved outwards. The gut is of remarkably small size and has an endocarp in the first loop. Van Name describes more longitudinal vessels between the folds than Pizon does. In this and in the position of the atrial orifice (Plate I, fig. B) the Barrier Reef specimen agrees with Pizon's. The folds of the branchial sac resemble Pizon's in projecting very slightly and being broad at the base. The mantle consists of an outer layer of transverse muscle, a middle layer of longitudinal muscles and an inner spongy layer.

The agreement with the published descriptions not being complete and material for comparison not being available, this determination is tentative.

Polycarpa fungiformis Herdman.

Polycarpa fungiformis Herdman, 1899, p. 43, pl. Cyn. xvi, figs. 1-10.

DISTRIBUTION.—Moreton Bay, Queensland.

OCCURRENCE.—St. XXV (1 specimen).

This specimen agrees exactly with Herdman's description, except that the dorsal fold on each side projects like the others.

The brown dots are found, not only in the mantle, but in the tissues of the branchial sac and endostyle.

Polycarpa cryptocarpa (Sluiter).

Styela cryptocarpa Sluiter, 1886, p. 210, pl. ii, fig. 1, pl. vii, figs. 1–3; 1891, p. 333.
Polycarpa cryptocarpa Hartmeyer, 1907, p. 17.
Pandocia (*Polycarpa*) *cryptocarpa* Michaelsen, 1911, p. 152.

DISTRIBUTION.—Billiton Is. (Dutch E. Indies), Japan.

OCCURRENCE.—St. II (1 specimen), St. XIX (3 specimens).

These specimens agree very closely with Sluiter's description. All those from St. XIX contain parasitic Crustacea resembling *Sphaerothylacus polycarpae* Sluiter, which was originally discovered in the type of *P. cryptocarpa*.

Polycarpa aurita (Sluiter). (Text-fig. 2 A–C.)

Styela aurita Sluiter, 1891, p. 338, pl. ii, fig. 12.
Polycarpa aurita Hartmeyer, 1919, p. 81, pl. ii, figs. 43–47 (synonymy); Sluiter, 1919, p. 3.

DISTRIBUTION.—N.W. Australia, Malaya.

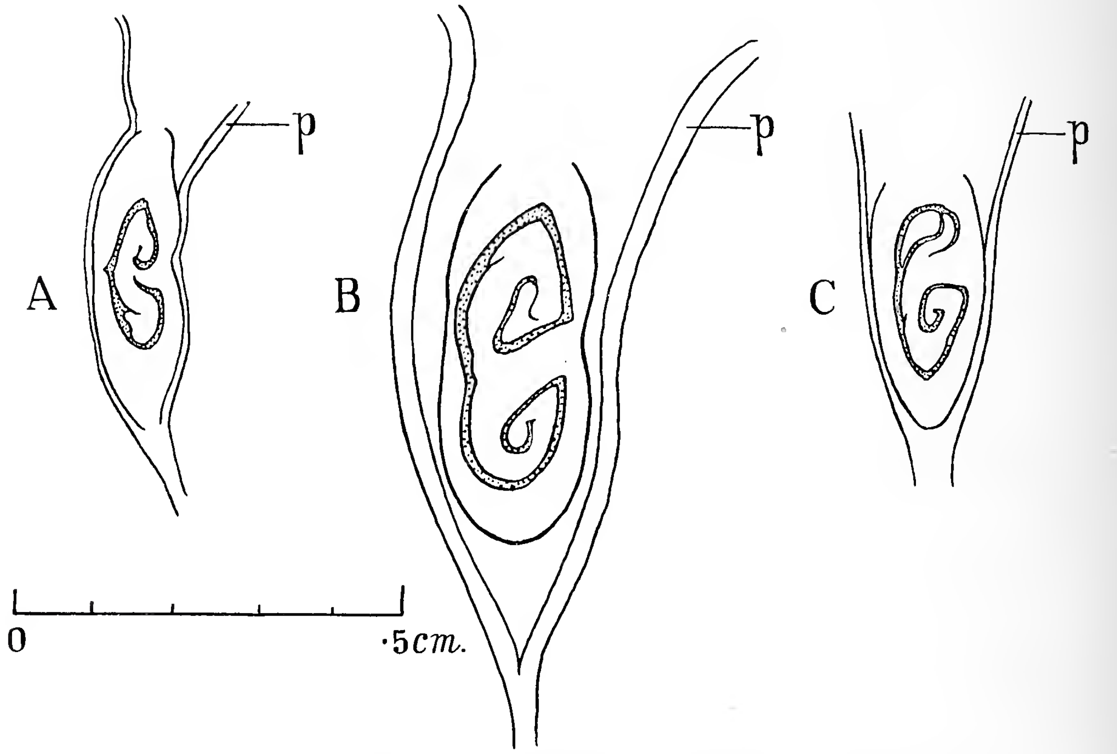
OCCURRENCE.—St. IX (1 specimen), XXIII (2 specimens), XIX (1 specimen).

The main part of the test of these specimens (except the one from St. XIX, which differs in various ways) is very dark brown, and the siphons and surrounding areas are deep buff colour. They are rather darker than Sluiter's types, kindly lent to me by the Amsterdam Museum. Those described by Hartmeyer have the lighter colour of the types. Posteriorly there is a distinct, flattened stalk with root-like processes at its end, In the specimen from St. IX the siphons are fairly prominent; in the others they are quite flat.

In internal structure these specimens agree with Hartmeyer's description. The dorsal tubercle is of the type figured by Hartmeyer, but the ciliated groove has no wider middle portion. Hartmeyer found a similar dorsal tubercle in one of the original specimens, but this is not the pattern in the holotype,* and a paratype examined by me (Text-figs. 2 A, C). In them there is a T-shaped ridge projecting inwards from the left side of the tubercle, with curled arms. The groove, therefore, describes a double spiral rather than a series of loops. The endostyle in the types and in the Barrier Reef specimens consists of a pair of tumid ridges with a narrow groove between. The ridges become less tumid posteriorly.

* Three unopened specimens, one of which I opened, and an open one, which I take to be the holotype, were lent to me.

The specimen from St. XIX measures 8·5 × 2·5 cm. and has no stalk. It differs from the other specimens of *S. aurita* chiefly in the branchial sac, which has much more numerous longitudinal vessels. The limits of the folds are so indistinct and the longitudinal vessels so numerous that accurate counting is impossible. There are roughly 40 vessels in the space between each pair of folds and 50 to 60 on each fold. The tentacles are small and fine, scarce and unevenly distributed, there being eight on the ventral side and none on the dorsal. Those of the type-specimens are evenly distributed, and may be thick (type) or thin (paratype). The dorsal tubercle is of the kind with a T-shaped ridge, but the arms are more coiled and both turn to the left (Text-fig. 2 B).



TEXT-FIG. 2.—*Polycarpa aurita* (Sluiter). Dorsal tubercle. A, Holotype. B, Specimen from St. XIX. C, Paratype. *p.*, peripharyngeal band.

Styela circumarata Sluiter (1904, p. 70) appears to be a closely related species.

The test round the branchial orifice of the specimen from St. IX bears Polyzoa of the genus *Nolella* (*Cylindroecium*).

Polycarpa procera (Sluiter). (Text-fig. 3.)

Styela procera Sluiter, 1886, p. 196, pl. i, fig. 9, pl. v, figs. 5–9.
Polycarpa procera Hartmeyer, 1919, p. 52, pl. i, figs. 24–26, text-figs. 5–13; Hartmeyer & Michaelsen, 1928, p. 378.

DISTRIBUTION.—Australia, Malaya.

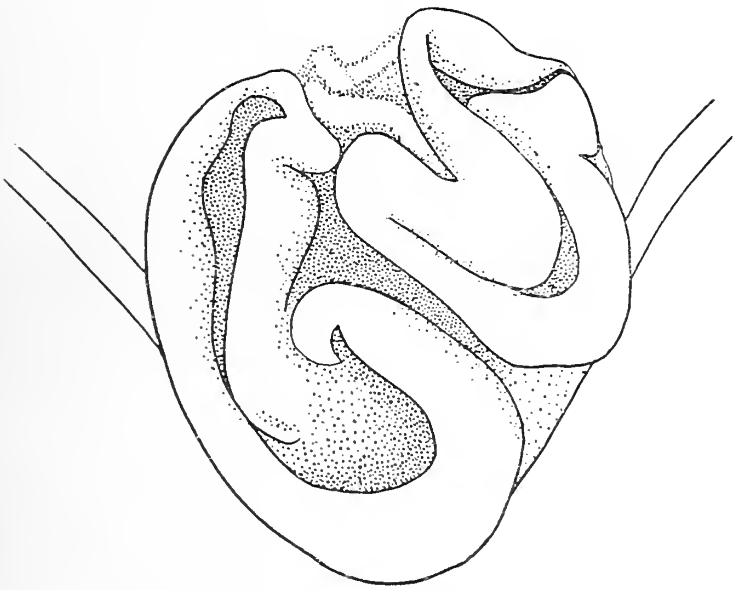
OCCURRENCE.—St. XXV (1 specimen).

This specimen resembles Hartmeyer's Text-fig. 7 in form, but the ventral end is somewhat turned towards the atrial orifice. The convex antero-ventral edge so produced bears a thick band of coarse sand and shell fragments. The rest of the test is uniformly

coated with sand and is brittle. The internal structure corresponds to Hartmeyer's description. The branchial sac is extremely transparent. The gut has the course shown by Hartmeyer in pl. i, fig. 26. There are twelve gonads on each side. The velum is wide and produced into two lobes, a blunt one on the dorsal side of the atrial aperture and a pointed one on the ventral side.

The dorsal tubercle (Text-fig. 3) resembles Sluiter's in being very irregular, but the pattern is quite different.

The lining of the branchial siphon bears a thick growth of a Gymnoblastic Hydroid.



TEXT-FIG. 3.—*Polycarpa procera* (Sluiter). Dorsal tubercle. Actual length of longest diameter, 1 mm.

Chorizocarpa sydneyensis (Herdman).

Chorizocormus sydneyensis Herdman, 1899, p. 95, pl. Pst. i, figs. 1–7.
Chorizocarpa sydneyensis Michaelsen, 1904, p. 93, pl. ii, figs. 24–26 (synonymy).

DISTRIBUTION.—Port Jackson.
OCCURRENCE.—Yonge Reef.

Botryllus gracilis Michaelsen. (Text-fig. 4 A–E.)

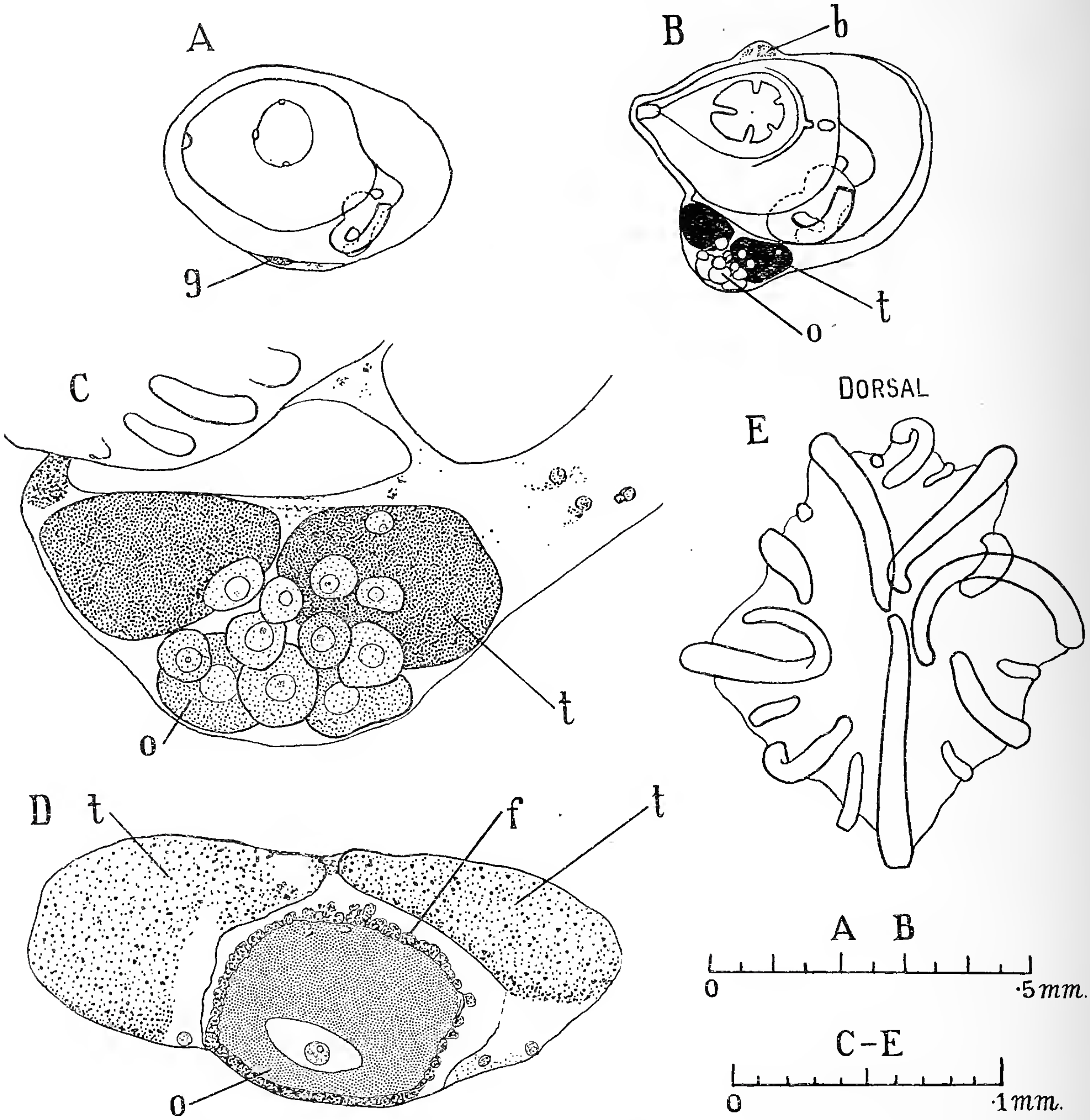
Botryllus gracilis Michaelsen, 1927, p. 203; Hartmeyer & Michaelsen, 1928, p. 338, fig. 22.

DISTRIBUTION.—Shark's Bay, S.W. Australia.
OCCURRENCE.—St. XXII, on sponge.

The formation of buds at the centre of the primary systems was not seen, but the agreement in other ways is so close as to leave no doubt of the identity of these specimens with Michaelsen's species. The long atrial siphon and the form of the stomach and caecum are specially characteristic points.

The tentacles are remarkable in that, although they occupy the positions in which they are usually found in *Botryllus*, they develop in sets of five instead of four, and, since

their relative sizes depend on the order of their development, the distribution of large and small ones in the adult zooid is different (Text-fig. 4 E). In Text-fig. 4 B the first five are formed, and in Text-fig. 4 A only the first three are distinguishable.

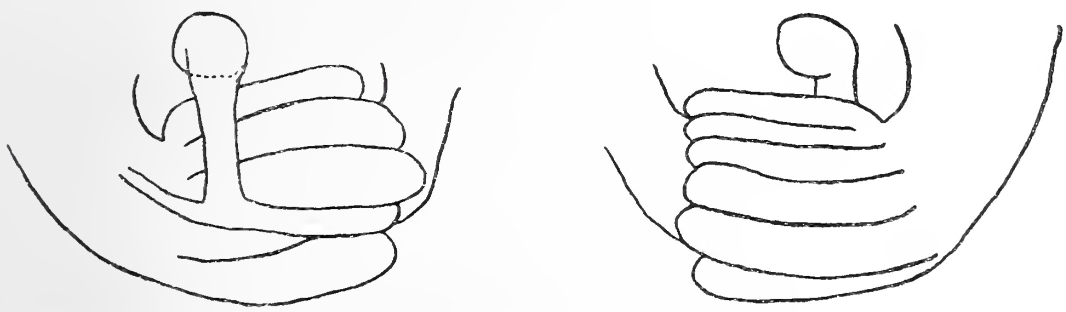


TEXT-FIG. 4.—*Botryllus gracilis* Michaelsen. A, Slightly oblique view of young zooid with first rudiment of gonad. Details of branchial sac omitted. B, Similar view of older zooid. C, Part of B, more highly magnified. D, Parasagittal section of gonad of still older zooid. E, Tentacles. (For explanation of lettering, see footnote, p. 73.)

The animals are hermaphrodite. Michaelsen found the gonads of one side usually more developed than those of the other, which were often completely absent.

In the present specimens gonads are developed on the left side only. A small bud occupies a corresponding position on the right side. In the zooids without gonads a bud is occasionally developed on the left side.

In the earliest stage seen the gonad is represented by a thickening of the inner wall of the mantle (Text-fig. 4 A). As the gonad develops, the mantle becomes distended till the gonad comes to lie in a wide space between the inner and the outer layer (Text-fig. 4 B, C). The testis, consisting of two follicles, occupies the inner part, and the ovary the outer. The vas deferens was not detected. The ovary at first consists of a large number of small eggs. Later, one of these increases greatly in size and becomes enclosed in a follicle. This egg comes to lie on the basal side of the testis (Text-fig. 4 D). In two such eggs a protuberance towards the inner side of the mantle was seen (*cf.* Ärnbäck, 1923, pp. 7, 14, etc.), but no trace of the formation of an oviduct. No later stage than this was found. In view of the work of Ärnbäck (1923) on the reproduction of *B. schlosseri* and *Botrylloides* (*Metrocarpa*) *leachii* particulars of other species are of much interest. It is unfortunate that the material of *B. gracilis* does not show the later stages which are of chief importance for classification. The early stages, however, afford comparisons of some interest. All three species agree in the position of the young gonads



TEXT-FIG. 5.—*Botryllus magnicoccus* (Hartmeyer.) Two views of the same stomach. × 120.

and their relation to the mantle. The development of gonads on one side only in *B. gracilis* and the double testis are obvious points of contrast. It is not clear whether the rudiments of ovary or testis appear first, but there can be no doubt that they appear at nearly the same time.

Botryllus magnicoecus (Hartmeyer). (Text-fig. 5.)

Botrylloides nigrum var. *magnicoecum* Hartmeyer, 1912, p. 271, pl. xli, fig. 11 ; 1913, p. 135.
Botryllus magnicoecus Hartmeyer & Michaelsen, 1928, p. 331 (synonymy).

DISTRIBUTION.—China, Indian Ocean, Portugal ? Mediterranean ?

OCCURRENCE.—Yonge Reef.

There is one small, almost colourless colony which shows the chief characteristics of this species, namely the stomach with nine folds and a very large caecum, the test-vessels with sharply defined, spherical ends, and the branchial sac with ten rows of stigmata. It differs in the shape of the stomach, which is as long or longer than it is broad, and has the cardiac ends of the folds prominent as in *Botrylloides* (Text-fig. 5). The buds have a thickening of the mantle posteriorly on the left side.

Ascidia sydneiensis Stimpson.

Ascidia sydneiensis Stimpson, 1855, p. 387 ; Hartmeyer & Michaelsen, 1928, p. 285 (synonymy).

Distribution.—Australia, Malaya, Indian Ocean, Atlantic.
Occurrence.—St. XII (1 specimen), XXV (2 specimens).

Ascidia granosa Sluiter.

Ascidia granosa Sluiter, 1904, p. 36, pl. v, figs. 1–14 ; Hartmeyer, 1907, p. 21.

Distribution.—Malaya (Siboga stn. 310), Japan, Holothuria Bank, N.W. Australia, 34 fms. (B.M. 92.1.29.402).

Occurrence.—St. XVII (1 specimen).

This specimen agrees very closely with Sluiter's description. Its dimensions are 5 cm. × 2 cm. The test is very thin, consisting of little more than an adhesive in the interstices of the layer of shell fragments, etc. The mantle and branchial sac, though brown, are very transparent, so that the outer covering can be seen through them.

Phallusia depressiuscula (Heller). (Text-fig. 6 a.)

Ascidia depressiuscula Heller, 1878, p. 87, pl. i, fig. 3.
Phallusia depressiuscula Van Name, 1918, p. 116, pl. xxvii, figs. 10–13, text-figs. 72–74.

Distribution.—Indian Ocean, Malaya.

Occurrence.—St. VIII (1 specimen), XIX (1 specimen).

These specimens can be identified with *Ascidia depressiuscula* as described by Heller and re-described by Van Name. The dorsal tubercle is small and round, with a transverse slit-like opening, thus resembling that of *Ascidia limosa* Sluiter (1887, p. 257) rather than that of *P. depressiuscula*. According to Van Name the opening in *P. depressiuscula* may be simple V- or U-shaped. The course of the digestive tract is similar to that shown by Van Name (figs. 72 and 73), but the loops are longer and narrower (Text-fig. 6 a). The papillae of the branchial sac are as figured by Van Name and have the membrane from their convex border extending halfway to the next longitudinal vessel.

As in Heller's specimen, the blood-vessels in the test are very finely and profusely branched and are conspicuous for their dark colour, which here is dark brown in the main trunks, blackish-purple in the ramifications.

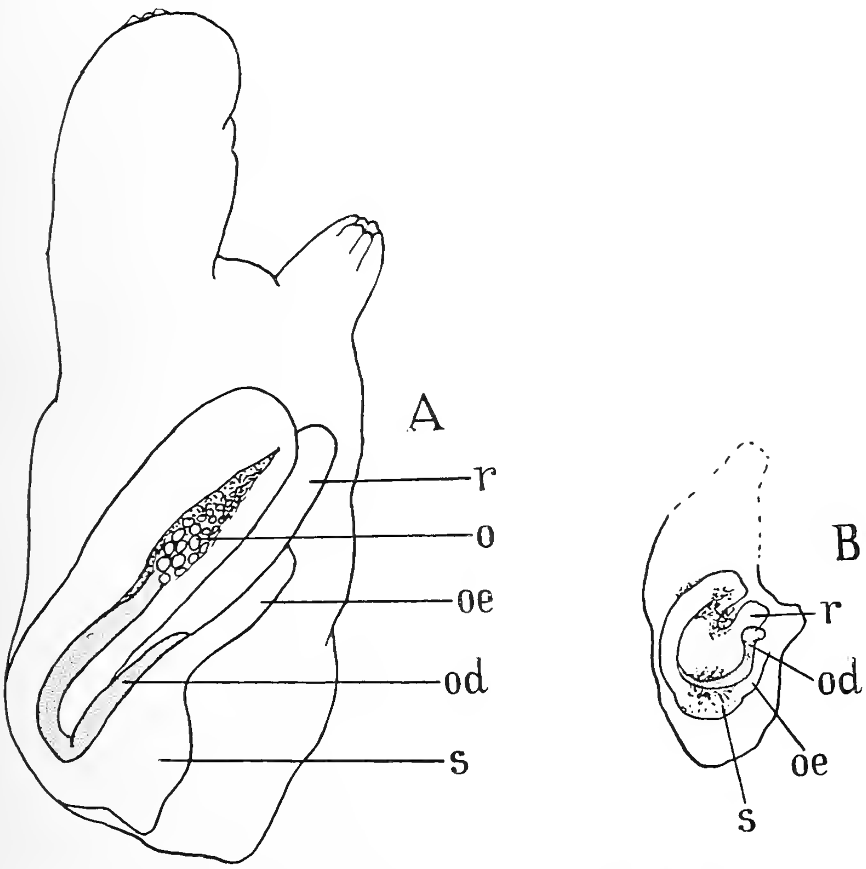
The Zoölogisch Museum, Amsterdam, kindly lent me the type-specimen of *Ascidia limosa* Sluiter for comparison with these specimens, and it seems worth while to record the following points in its structure : The animal without the test measures 2·2 cm. × 1 cm. The intestine is rather more inflated at the second bend than is shown in Sluiter's figure (Text-fig. 6 b). A thick genital duct runs between the rectum and the œsophagus. The branchial sac extends beyond the viscera posteriorly. There is a row of short transverse muscles bordering the right side of the mantle just as in *Ascidia sydneiensis.* The papillae of the branchial sac are thicker and blunter than in Sluiter's figure, and may have blunt lateral processes. They somewhat resemble those of *P. depressiuscula*, but there is no membrane extending from the papillae along the transverse vessels.

Phallusia julinea Sluiter.

Phallusia julinea Sluiter, 1919, p. 7, pl. i, figs. 13–16; Hartmeyer, 1919, p. 99, pl. ii, figs. 51–53, text-fig. 20; 1927, p. 165, text-fig. 2.

Distribution.—Java Sea, N. and E. Australia.

Occurrence.—St. IX (1 specimen), XXIII (1 specimen).



Text-fig. 6.—A, *Phallusia depressiuscula* (Heller). B, Type of *Ascidia limosa* Sluiter. Branchial region was separate, dotted outline therefore approximate. Both × 2. (For explanation of lettering, see footnote, p. 73.)

Podoclavella meridionalis Herdman. (Plate I, figs. D and E.)

Podoclavella meridionalis Herdman, 1891, p. 603; 1899, p. 4, pl. Clav. ii, figs. 1–4; Hartmeyer, 1919, p. 104.

Distribution.—Port Jackson, N.S.W., Cape Boileau (B.M. 30.9.23.7) and Cape Jaubert, N.W. Australia.

Occurrence.—St. XXII (1 specimen).

This specimen agrees very closely with Herdman's description. Its dimensions are as follows: Total length, 10 cm.; length of stalk 6·5 cm.; breadth of stalk ·2 cm.; breadth of body at widest part ·8 cm. (Plate I, fig. D). The test contains feathery crystals soluble in nitric acid, but these were not seen in the Cape Boileau specimens.

The mantle is a more or less deep purple colour over the abdomen and the sides of the thorax. Over the atrium it is colourless and transparent. In this region there are

some longitudinal muscle-bands whose ends turn round and give the effect of a longitudinal row of short transverse muscle-bands, showing white against the purple sides. The horizontal membranes of the branchial sac are wide and bright yellow. Their colour can be seen externally through the transparent atrial part of the mantle as yellow stripes. The dorsal tubercle is oval, placed longitudinally, with a slit-like opening in its long axis. There are a number of embryos in the atrium.

The specimens from Cape Boileau have shorter, thicker, less horny stalks (Plate I, fig. E), less yellow pigment, and the longitudinal musculature is not so regular.

Podoclavella molluccensis Sluiter. (Plate I, fig. F.)

Podoclavella molluccensis Sluiter, 1904, p. 5; Van Name, 1918, p. 130, figs. 85–87.
Clavelina (*Podoclavella*) *meridionalis* Sluiter, 1895, p. 165, pl. vi, figs. 1–4.
Podoclavella meridionalis Pizon, 1908, p. 197, pl. ix, figs. 1–4.
non *P. meridionalis* Herdman, 1891, p. 603; 1899, p. 4.

DISTRIBUTION.—Cape Boileau, N.W. Australia (B.M. 30.9.23.8), Malaya.

OCCURRENCE.—St. XIX on *Pyura momus* form *grandis*.

The colonies are characteristic in form and colour. The yellow band below the siphons is continued as a stripe down the atrial wall as described by Pizon, and there may be a patch of yellow over the proximal end of the endostyle. The basal common test is not very thick (3 mm. at most), but the tips of the viscera are embedded in it. In the mantle there are longitudinal muscle-bands, and underneath them a more or less continuous layer of transverse muscle as described by Van Name. The longitudinal muscles can hardly be detected by reflected light and this probably led Sluiter to overlook them. Plate I, fig. F, shows the specimen from Cape Boileau.

Michaelsen (1930, pp. 466 and 476) distinguished his subfamily Clavelininae from the social forms of Polycitorinae by the unlobed branchial aperture. Van Name described his specimens as having a six-lobed branchial aperture, and Michaelsen (p. 467) would therefore put this species in *Polycitor*, but other authors describe it as plain, and it certainly is so in the present specimens.

Eudistoma ovatum (Herdman). (Plate I, fig. C; Text-figs. 7 A–C, 8 A–C.)

Psammaplidium ovatum Herdman, 1886, p. 246, pl. xxxi, figs. 13–16.
Polycitor (*Eudistoma*) *paesslerioides* Michaelsen, 1914, p. 428; 1915, p. 440; 1921*b*, p. 7 (var. *hupferi ?*).
? *Eudistoma paesslerioides* var. *hupferi* Sluiter, 1927, p. 80.

DISTRIBUTION.—Torres Straits, Cape Boileau, N.W. Australia (B.M. 30.9.23.19), Indian Ocean ? W. Africa, Morocco ?

OCCURRENCE.—St. XVII (1 colony).

This colony, which is incomplete basally, measures 2·8 × 1·5 cm. It is club-shaped (Text-fig. 8 C), and was presumably fixed by its narrow base. The colony from Cape Boileau (Plate I, fig. C) has a diameter of 16 cm. and is 9 cm. in height. The Barrier Reef specimen agrees very closely with Herdman's types which are in the British Museum. The surface of the colony bears a regular layer of fine sand, which is only interrupted by the apertures of the zooids. Internally the sand-grains are larger and irregularly scattered. The zooids measure 8–10 mm. when well expanded. Herdman gave the length as 4 mm.,

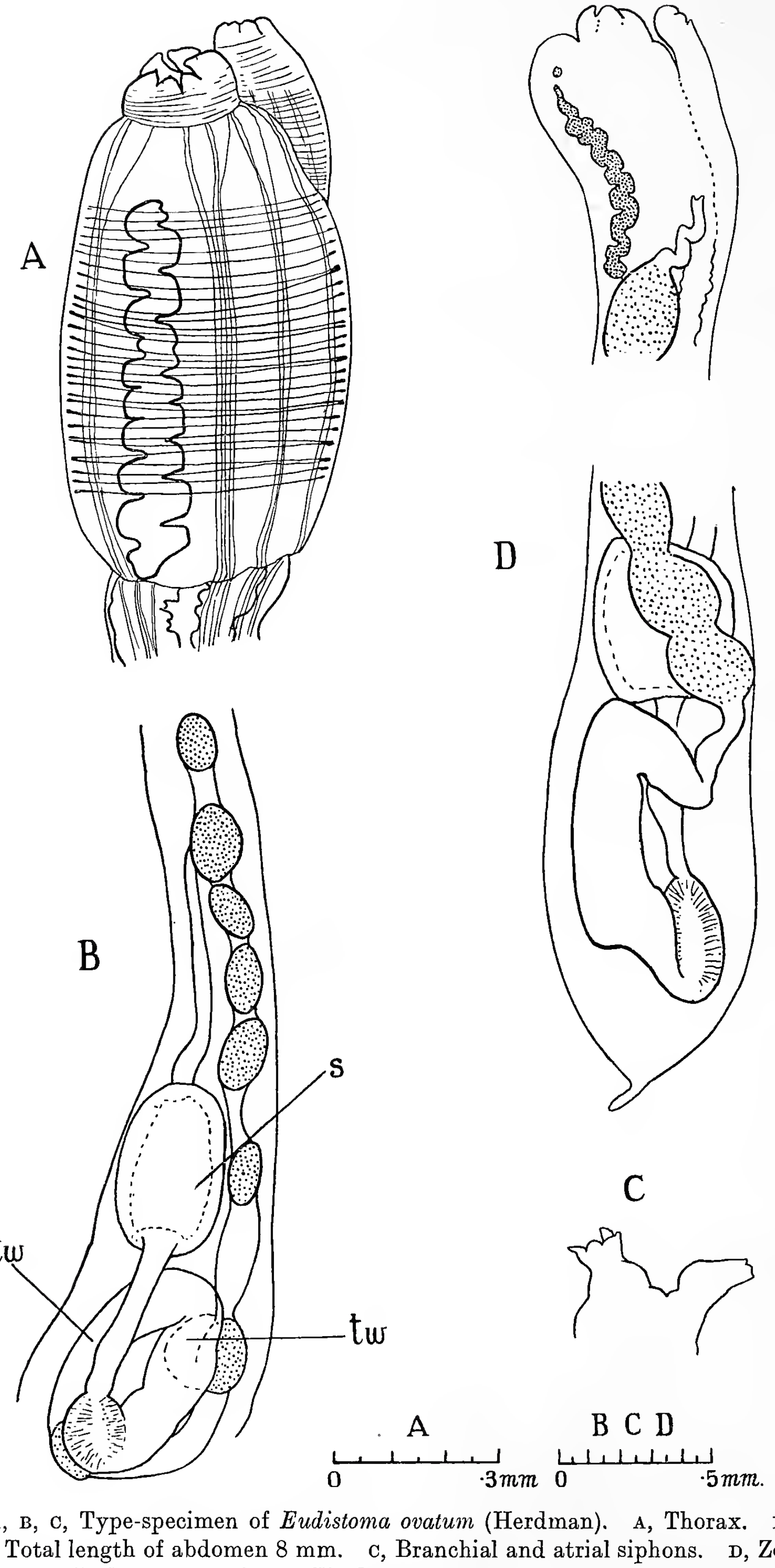
and many contracted zoöids in his specimens are no longer than this. Others, however, are expanded, and are as long as those from the Barrier Reef. They consist of a relatively short thorax and a very long abdomen. The end of the abdomen, containing the stomach and gonads, is as wide as the branchial sac, but the part between, through which the oesophagus and rectum pass, is narrower. This contracted part is the structure regarded by Herdman as an elongated post-abdomen. The tip of the abdomen is pointed and continued as a thread in the test for some distance. The transverse musculature on the thorax is very conspicuous on contracted zooids (Text-fig. 7 A). There are 4–6 longitudinal muscle-bundles on each side of the thorax, which coalesce to form broader bundles on the abdomen. The branchial and atrial siphons are six-lobed, and open directly on the surface of the colony.

Owing to contraction of the thorax, the arrangement of the tentacles in the type cannot be made out clearly. They are numerous and elongated. In the specimen from Cape Boileau (Text-fig. 8 A) they are arranged in several rows over a rather wide zone at the base of the branchial siphon. The short atrial siphon, at right angles to the thorax, shown in the figure is not characteristic. In most zooids it is directed forward beside the branchial siphon, and appears as long as the branchial siphon (Text-fig. 8 B), or even longer. In Herdman's specimen there are generally two complete twists in the intestinal loop (Text-fig. 7 B). One twist may occur in the Barrier Reef specimen. The difference presumably depends on the degree of contraction of the zooid. It can hardly be regarded as of systematic importance. The ovary may contain two good-sized eggs. The testis consists of numerous spherical follicles. There may be one or two embryos in the atrium, which is then more or less distended, but there is no distinct brood-pouch.

Hartmeyer (1909, p. 1470) pointed out the artificiality of the genus *Psammaplidium*. There can, I think, be no doubt of the propriety of putting *P. ovatum* in *Eudistoma*, whatever views may be held about the relation of that subgenus to the other Polycitorinae (see Michaelsen, 1930, p. 476).

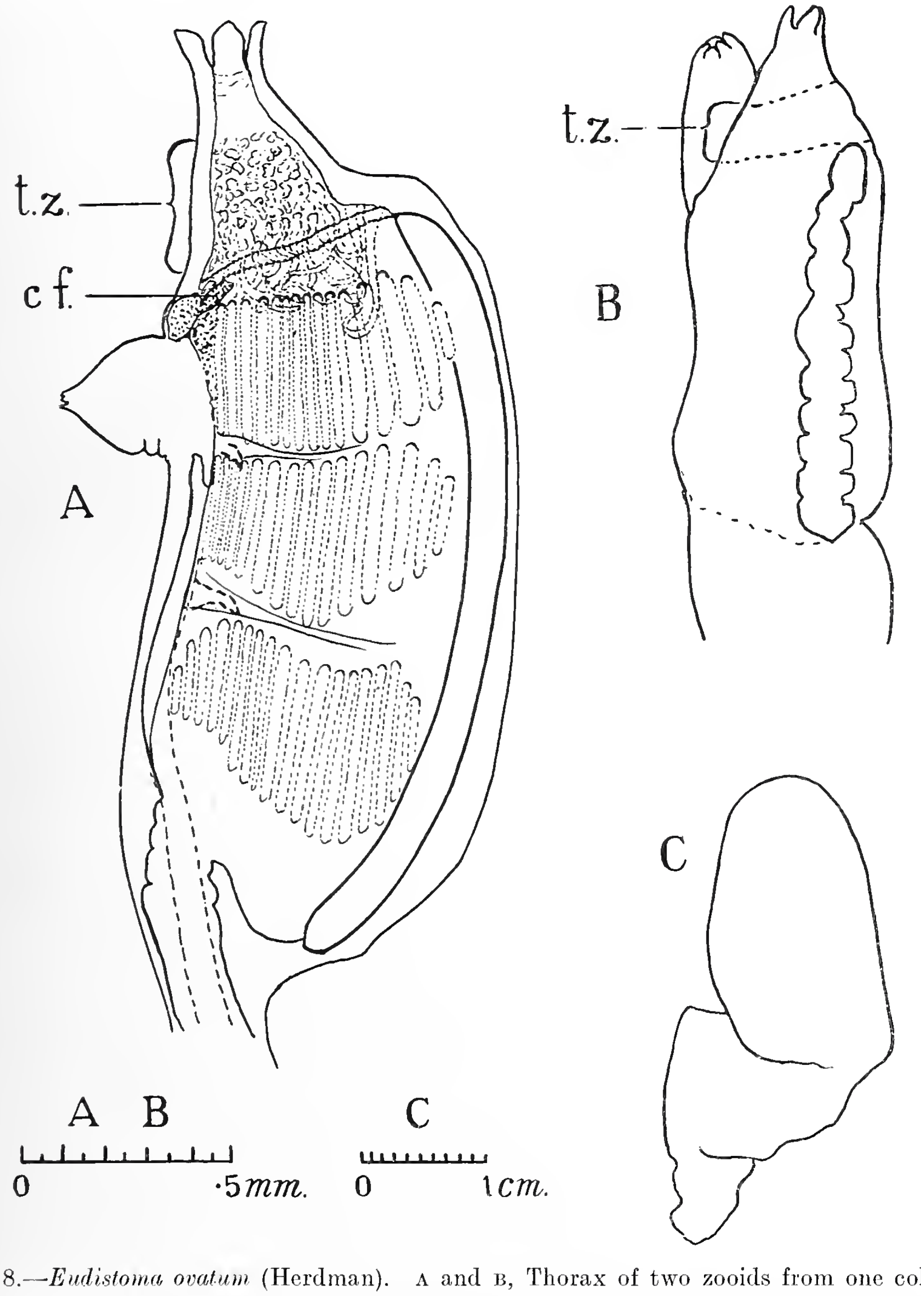
The species identified with *Psammaplidium ovatum* Herdman by Sluiter both appear to be distinct. In that from Torres Strait (1895, p. 170, pl. vii, figs. 3–5) the zooids have a post-abdomen, an atrial languet, longitudinal folds on the stomach, and more than three rows of stigmata. That from between Sumbawa and Celebes (1909, p. 100) evidently had short zooids, for he says that it agrees with Herdman's description and it is included in *Aplidium*. I have, on the other hand, no doubt that *Polycitor* (*Eudistoma*) *paesslerioides* Michaelsen is a synonym of *E. ovatum*. It is not clear to which, if any, of Michaelsen's varieties of *E. paesslerioides* the Australian specimens belong, and he says himself (1930, p. 492) that some of his varieties may be found not to stand. The small number of longitudinal and transverse muscle-bundles bring the type-specimen of *E. ovatum* nearer to var. *hupferi*, and this view is supported by the only half-series that can be counted containing twelve stigmata. The form of the atrial siphon, though varying according to the degree of contraction, is not against this conclusion. The Barrier Reef and Cape Boileau specimens have more numerous stigmata (14–18 in a half-row). There are 7 or 8 longitudinal muscle-bundles and more than 30 transverse bands.

Herdman (1899, pp. 85–89) records eight species of *Psammaplidium* from Australia. Five of these species have not been available for examination, but appear to belong to the Polyclinidae. The other three are *P. ovatum*, *P. spongiforme* and *P. pyriforme*. The accuracy of Herdman's description of *P. spongiforme* has been confirmed by examination



TEXT-FIG. 7.—A, B, C, Type-specimen of *Eudistoma ovatum* (Herdman). A, Thorax. B, Tip of abdomen. Total length of abdomen 8 mm. C, Branchial and atrial siphons. D, Zooid from type-specimen of *Eudistoma pyriforme* (Herdman). Middle part omitted. Total length of zooid 6 mm. *s.*, stomach. *tw.*, twist in intestine.

of the type (B.M. 87.2.4.382). According to his definition of the genera of Polyclinidae, Hartmeyer (1909, p. 1464) justly included this species in *Macroclinum*. Examination of the type of *P. pyriforme* (B.M. 87.2.4.482) shows that it is a *Eudistoma*, closely allied to

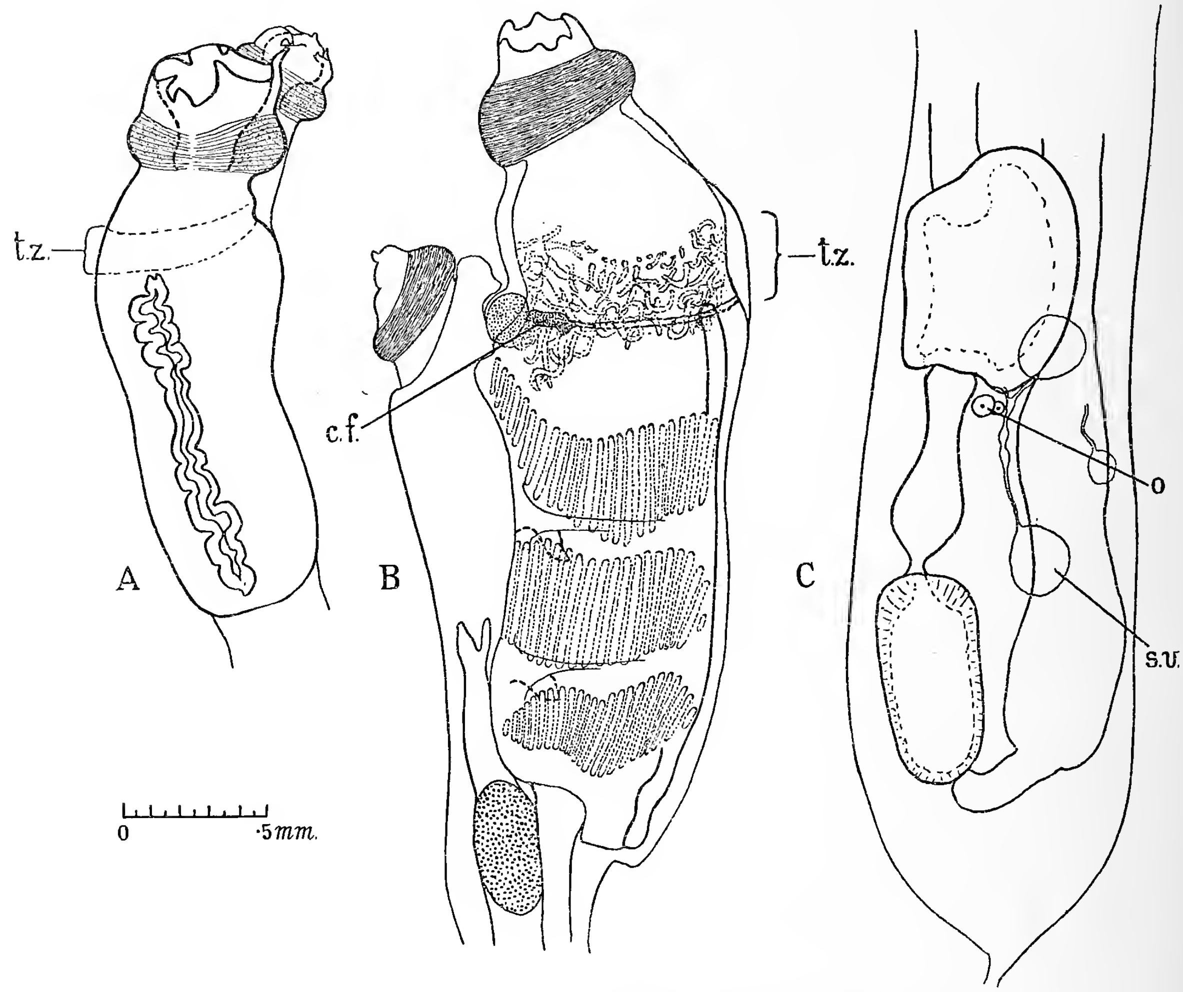


TEXT-FIG. 8.—*Eudistoma ovatum* (Herdman). A and B, Thorax of two zooids from one colony from Cape Boileau. Musculature omitted. C, Outline of colony from Barrier Reef. *c.f.*, ciliated funnel. *t.z.*, tentacular zone.

E. ovatum. The colonies are smaller and, owing to the more numerous sand-grains in the test, harder than those of *E. ovatum*. The broad distal end is flattened and wrinkled. The zooids adhere more closely to the test than in *E. ovatum*. They are not numerous and are much contracted. The one figured (Text-fig. 7 D) is 6 mm. long. The siphons

appear rather more muscular than those of *E. ovatum* without having a definite sphincter. There are very numerous transverse muscle-bands on the thorax (about 60, but accurate counting is impossible), and 7 (or 8 ?) longitudinal bundles of varying thickness. The thick-walled oval section of the intestine is rather more sharply defined than in *E. ovatum.*

Another Australian *Eudistoma* of the *Psammaplidium* type appears to be identical with *Polycitor* (*Eudistoma*) *angolanus* Michaelsen (1915, p. 452) = *P. paesslerioides* var. *angolanus* Michaelsen (1914, p. 430) from W. Africa. A colony of this species from Cape



TEXT-FIG. 9.—*Eudistoma angolanum* Michaelsen. From Cape Boileau, N.W. Australia. A, Contracted thorax. B and C, Thorax and abdomen of expanded zooid from the same colony. Total length of zooid, 13 mm. Musculature, except sphincters, omitted. (For explanation of lettering, see footnote, p. 73.)

Boileau (B.M. 30.9.23.20), which has had a piece cut off, must have been roughly hemispherical when complete. It is 8 cm. in diameter and 3·5 cm. deep at the centre. It was attached by the central area of the more or less flat basal surface. The foreign particles in the test are less numerous in the upper regions than they are in *E. ovatum,* and there are granules of almost black pigment here and there, but not in sufficient quantity to affect the colour of the colony as a whole. A well-expanded zooid, dissected unbroken from the colony, is 13 mm. long, exclusive of the thread-like continuation of the abdomen,

but the majority are less owing to immaturity or contraction. The very thick band of muscle round each siphon (Text-fig. 9 A, B) is sharply defined, and produces a convexity both inside and outside the siphon. It is not completely circular, being interrupted on the outside, *i. e.* at the point furthest from the other siphon. The atrial siphon may appear longer or shorter than the branchial siphon. The tentacles are numerous and arranged in several rows. As in *E. ovatum* the ciliated funnel forms a conspicuous projection below the central nervous system (Text-figs. 8 A, 9 B, *c.f.*). The stomach is smooth and more or less round. The first part of the intestine is wider posteriorly and is separated by a deep constriction from the second part, which is oval, thick-walled and very clearly defined (Text-fig. 9 C). The next section begins very narrow, widens rather suddenly and narrows very gradually for the rest of its length. The regions of the intestine of *E. ovatum* correspond to these, but are much less sharply defined (Text-fig. 7 A). Another peculiarity of this specimen is the presence of stalked, membranous vesicles beside the intestinal loop (Text-fig. 9 C, *s.v.*). Possibly they are empty testis follicles.

Michaelsen divided *E. angolanum* into two varieties. In its sphincter muscles and the number of longitudinal muscles the Australian form resembles var. *togoense*, but instead of 80, less than 60 transverse muscle-bundles were counted.

The Cape Boileau specimen of *E. angolanum* is clearly identical with the form from N.W. Australia identified by Hartmeyer (1919, p. 105) with *Polycitor amplus* Sluiter (1909, p. 21). Zooids from the same colony as those figured here (Text-fig. 9) resemble Hartmeyer's fig. 54 in the narrowness of the siphons below the sphincter. The appearance of a longitudinal fold on the stomach shown in Hartmeyer's fig. 55 is seen in some zooids, but this is not structural, for sections and well-expanded zooids show that the stomach is smooth, as was recognized by Hartmeyer. Sluiter's figure does not show either of the chief peculiarities of this species, namely the conspicuous muscle-bands on the siphons and the sharply-defined oval section of the intestine, and it seems possible that the Australian form is distinct from *E. amplum*.

There are thus three Australian sandy species of *Eudistoma* known, of which *E. ovatum* and *E. angolanum* are distinguished by the form of the siphons, the intestine and the colony, and the third species, *E. pyriforme*, is in some ways intermediate, but is only known from the rather poor type-specimen, consisting of half of one colony and some small fragments. The differences in size seen in the accompanying figures of these species are not constant, and depend very much on the degree of contraction.

Sigillina deerrata (Sluiter). (Text-fig. 10 A, B.)

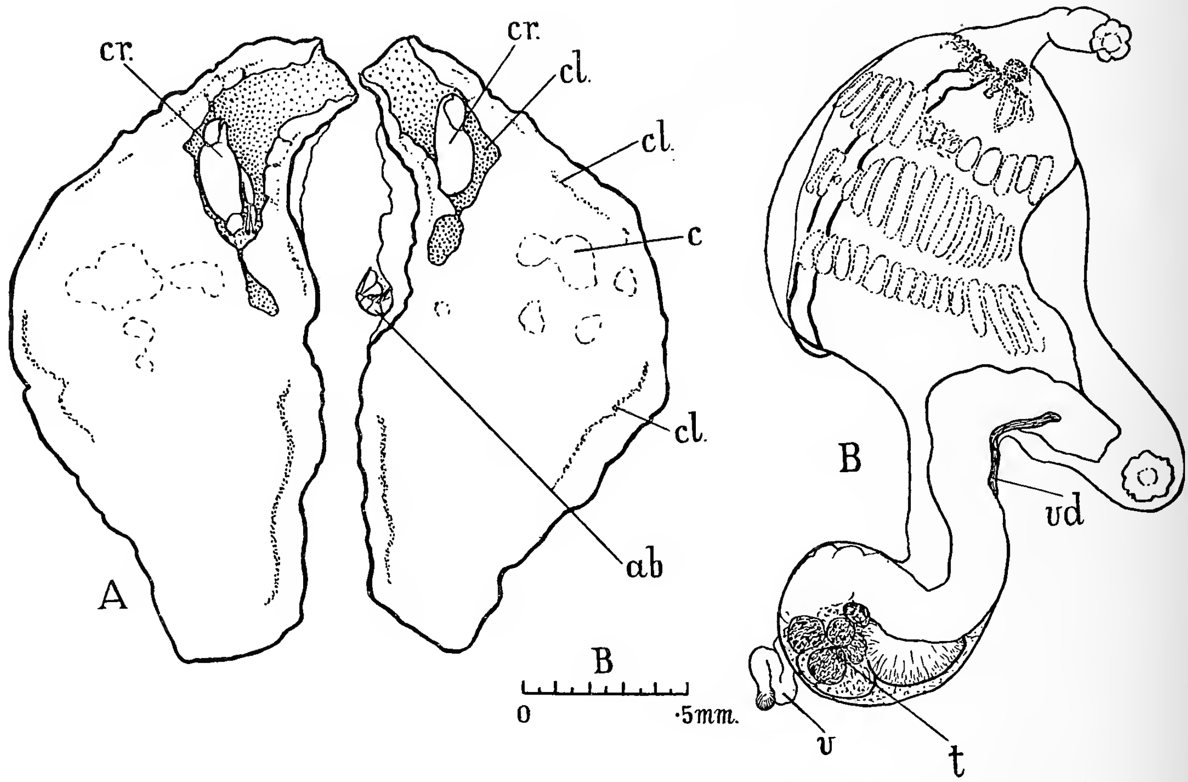
Distoma deerratum Sluiter, 1895, p. 167, pl. vi, figs. 5–7.
Polycitor coalitus Sluiter, 1909, p. 23, pl. ii, fig. 4, pl. vi, fig. 1.
Sigillina (*Polycitor*) *coalita* Michaelsen, 1930, p. 484.

Distribution.—Torres Strait, Malaya (Siboga St. 164).

Occurrence.—St. XVII (3 colonies).

These colonies are all more or less egg-shaped, with a large cloacal orifice at one end (Text-fig. 10 A) and a few scraps of calcareous alga adhering at the other. The largest is 7 cm. high and 5 cm. in diameter at the widest part. The other two are a good deal smaller. The cloacal aperture has a thin vertical rim. The colonies are a pinkish-brown

colour. The zooids are arranged in systems of irregular size and shape, with smaller zooids at the centre and larger towards the outside. The systems are most numerous at the anterior end and are absent from the posterior end. The systems have no cloacal opening to the outside. Their central cavity opens into the cloacal canal, which occupies a layer a little below the surface of the colony, and completely below the zooids. Many of the zooids do not communicate with the common cloaca of their system, their atrial siphon opening into a channel of the test passing directly to the cloacal canal. The centre of the colony consists of firm, but gelatinous test, with a few cavities in its anterior part (Text-fig. 10 A, *c*.). In the smaller colonies this central column extends to the cloacal



Text-fig. 10.—*Sigillina deerrata* (Sluiter). A, Large colony cut in half, showing Crustacea in the cloacal canals. B, Zooid from one of the small colonies. (For explanation of lettering, see footnote, p. 73.)

aperture, forming a sort of plug. In the large colony there is a larger space occupied by the claws of two Decapod Crustaceans. These commensals lie in the cloacal canal at diametrically opposite points. They each have one very large claw, which is extended towards and very nearly reaches the cloacal aperture (Text-fig. 10 A, *cr.*). One of the smaller colonies contains a similar but smaller Crustacean, in a more posterior portion of the cloacal canal. The absence of the plug in the cloacal aperture of the large specimen is probably due to the presence of the Crustacea.

The central column contains calcareous crystals of various form. In the large colony they are linear and arranged in a feathery formation. In the smaller colonies similar elongate crystals are attached to short thick rods.

A zooid is shown in Text-fig. 10 B. The stigmata may be much less irregular than in the one figured. There is a fairly regular network of fine longitudinal and transverse muscles on the thorax. The vascular process varies very much in length.

I have examined the type-specimens of *Distoma deerratum* Sluiter and *Polycitor coalitus* Sluiter, and have satisfied myself that they are synonymous and that the present specimens belong to the same species. The form of the colony is the same in all. The two type-specimens appear to have been somewhat crushed in preservation, giving them the tongue-like shape described by Sluiter. They both have a large terminal cloacal aperture, plugged by the central column of the test. *P. coalitus* has feathery crystals like those of the large Barrier Reef specimen. The wavy-edged stigmata, mentioned by Sluiter in *D. deerratum*, are characteristic of all the specimens. The irregular fourth row of stigmata described in the same species has not been seen. The length of the vascular processes and branchial siphons is extremely variable in all specimens.

From Sluiter's description *D. deerratum* appears to differ from *P. coalitus* in the number of stigmata in a row, the presence of papillae in the branchial siphon and the form of the alimentary canal. Adult zooids of *D. deerratum* have, however, as many stigmata as those of *P. coalitus*, the structure of the alimentary canal is essentially the same and no trace of papillae can be found in the branchial siphon, though in an oblique view the tentacles may give such an impression.

The generic position of this species is obscure. The method of budding, the vascular process (or epicardial post-abdomen), the lobed atrial orifice and the musculature of the thorax clearly show its affinities with *Polycitor*, as was recognized by Sluiter. The cloacal system with a single large cloacal aperture at the apex of the colony and the zooids with long, backwardly curved atrial siphon and small round abdomen afford an interesting parallel with *Didemnopsis*.

In classifying the species of *Polycitor*, Michaelsen (1930, p. 479) regards the number of rows of stigmata as important and reserves *Polycitor* for species with more than three rows. He uses *Sigillina* as a wide genus to cover all the species with three rows pending their re-classification, and defines a number of subgenera of this genus. The cloacal system of *S. deerrata* excludes it from all these subgenera.

Trididemnum cyclops Michaelsen. (Plate II, fig. B; Text-fig. 11.)

Trididemnum cyclops Michaelsen, 1921*a*, p. 19, pl. i, fig. 10.
? *Trididemnum planum* Sluiter, 1909, p. 42, pl. iii, fig. 12, pl. vii, fig. 7; Michaelsen, 1920, p. 6.

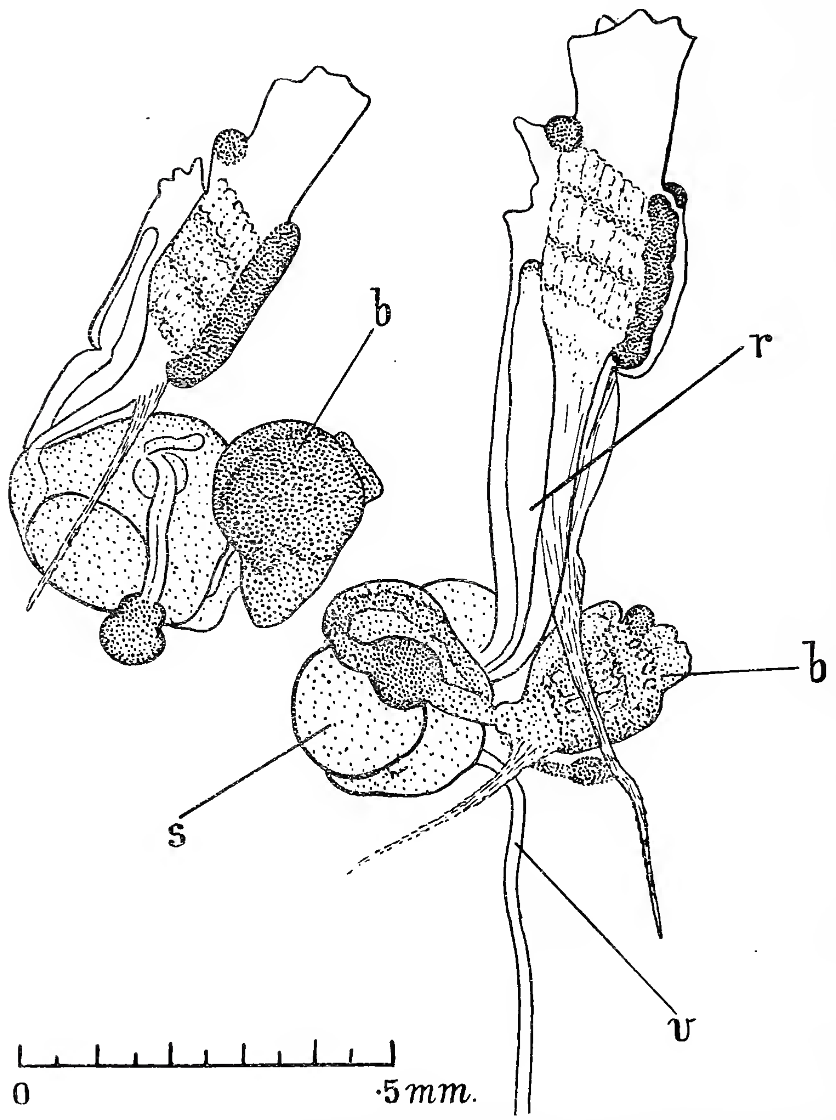
DISTRIBUTION.—Malaya ? Madagascar.

OCCURRENCE.—G. 3.

The colonies are thicker than Michaelsen's, being ·2–·3 mm. thick and having a cushion-like appearance. They are pale buff with white edges of very variable width. They agree in the distribution of spicules, excretory granules and bladder-cells and in the presence of numerous spherical bodies in the cloacal canals. Dr. C. M. Yonge finds that these bodies are zooxanthellae. The spicules are larger than described by Michaelsen. There is very little pigmentation, even the black cap on the endostyle being very rarely present. The zooids are similar in general form. The branchial siphon is longer and thicker and its dorsal lobe tends to project. The atrial siphon is usually as described by

Michaelsen, but in some (young ?) zooids it is more anterior, tubular and lobed (Text-fig. 11, smaller zooid).

The cloacal canals and the thoracic portions of the zooids occupy the region between the two layers of spicules, and in a hand-section such as that figured (Plate II, fig. B) the zooxanthellae (*z.*) can be seen to be massed in great numbers in this region. They are not



TEXT-FIG. 11.—*Trididemnum cyclops* Michaelsen. Two zooids in their natural juxtaposition. (For explanation of lettering, see footnote, p. 73.)

found elsewhere. Dr. Yonge finds that they are not of the same kind as those in *Diplosoma virens*.

T. cyclops may prove to be synonymous with *T. planum* Sluiter, which resembles it in many ways. Spicules and bladder-cells are similarly distributed. The spicules resemble those of the Barrier Reef specimens in size. The atrial siphon is longer and unlobed. The zooxanthellae are not mentioned unless, as seems possible, they are referred to as pigment-cells.

Trididemnum savignii (Herdman).

Didemnum savignii Herdman, 1886, p. 261, pl. xxxiv, figs. 1–5.
Trididemnum savignii Van Name, 1921, p. 314, text-figs. 7–9 (synonymy); 1924, p. 25; Sluiter, 1927, p. 89.
? *Didemnum areolatum* Herdman, 1906, p. 337, pl. viii, figs. 26, 27.

Distribution.—Indian Ocean, Morocco, W. Indies.

Occurrence.—St. XIX (1 colony).

This colony forms an irregular incrustation measuring 5·5 by 2 cm. and 1–2 mm. thick. It is a dirty, rather speckled, grey colour, owing to the irregular distribution of the spicules in the upper layers of the test, the yellowish-brown colour of the zooids and the grey of the test. There is a narrow grey border free from zooids and spicules. The cloacal apertures are round and shallow and 2–3 mm. in diameter. They are conspicuous owing to the narrow black rim of their orifice, and to a dense layer of spicules in the floor of the cloacal canal showing through the opening. The test consists of three layers. The layer above the cloacal canals contains scattered spicules in dense clumps and singly. The clumps do not coincide with the branchial apertures. Below the cloacal canals, forming their floor, is a thin layer of very closely placed spicules. This layer is at the level of the neck of the zooids. Below this spicules are extremely rare and the test is packed with bladder cells. The spicules resemble those figured by Van Name. The largest are ·08 mm. in diameter. Besides the black pigment in the rim of the cloacal orifice, there is pigment in the test in the interstices of the bladder-cells and in the mantle on thorax and abdomen.

The branchial and atrial siphons are short and lobed. The thorax is smaller than the abdomen. The neck is narrow, but not very long, and the abdomen is turned sideways. The retractor is about as long as the abdomen. Owing to pigmentation the details of the internal structure cannot readily be made out. There are three rows of stigmata. The stomach is long and oval with cardiac and pyloric inpushings. No reproductive organs were seen.

Examination of the type of *Didemnum areolatum* Herdman (B.M. 07.8.30.36) shows that it agrees with the present specimen in the shape, size and distribution of the spicules, except that the largest are even larger. It differs in pigmentation; the general colour is a yellowish brown, due to brown pigment-granules which are scattered in the test below the spicule layer, and are concentrated above the spicules in the floor of the cloacal canals. The zooids are also yellowish brown in colour, with some brown pigment on the branchial siphon and the thoracic tubercles. The blackish pigment of the Barrier Reef specimen is absent. The cloacal apertures are visible. The retractor is rather short. These differences are slight in themselves and fall well within the range of variation attributed to *T. savignii*, with which I think *D. areolatum* is synonymous. Herdman's figures are misleading, giving no indication of the arrangement of the spicules in a dense layer below the cloacal canals, nor that the bladder-cells are closely packed throughout the part below the spicule layer, although both of these are characteristic features of the type-specimen. A good deal is made of the arrangement of the zooids in systems. This effect is much less definite than fig. 26 would suggest, and in basal view, where the zooids are much more distinctly visible, they can be seen arranged in sinuous lines. The testis is a single follicle round which the vas deferens makes about eight turns.

In the pigmentation of the zooids and particularly of the cloacal apertures, the Barrier Reef specimen of *T. savignii* resembles the encrusting specimen of *Didemnum ramosum* Sluiter (1909, p. 63) from Sailus Ketjil, which, however, had 4 rows of stigmata.

Trididemnum natalense Michaelsen.

Trididemnum natalense Michaelsen, 1920, p. 3, text-fig. 1.

Distribution.—Natal.

Occurrence.—St. XIX (1 colony).

This colony agrees with *Trididemnum natalense* Mich. except in the distribution of the spicules, which are irregularly scattered in small clumps and form no continuous layer. The branchial sac usually agrees with Michaelsen's figure, but occasionally the stigmata are considerably longer. Only female reproductive organs were seen. Michaelsen found male gonads only.

Van Name (1921, p. 314) gave this as a doubtful synonym of *T. savignii*. As it is distinguished by the distribution of spicules and pigment from the specimen of *T. savignii* from the same locality on the Barrier Reef, it has seemed best to treat it as distinct for the present.

Leptoclinides reticulatus (Sluiter).

Didemnum reticulatum Sluiter, 1909, p. 60.
Leptoclinides sparsus Michaelsen, 1924, p. 336, text-fig. 13.

Distribution.—New Zealand, Malaya (Siboga, St. 37).

Occurrence.—St. XII (1 colony).

It is surprising to find, on examining the type, that *D. reticulatum* is a *Leptoclinides*. The zooids are of the characteristic form with a backwardly-directed atrial siphon opening into cloacal canals that run below the zooids, rather conspicuous longitudinal musculature on the thorax and the characteristic thoracic tubercles. Mature gonads were not seen, but the testis appears to be divided. The test has a layer of bladder-cells at the surface. Below this is a zone containing spicules, which are most numerous in its upper part. This zone has irregular spindle-shaped or branched pigment-cells. The pigment-cells are chiefly congregated just below the bladder-cell layer, but are found here and there lower down. Below the spicule-zone the test consists almost entirely of bladder-cells, but a few spicules are found in this part, especially at the basal surface. The zooids and cloacal canals occupy the spicule zone. The spicules are, on the average, ·03 mm. in diameter, and may attain ·04 mm. Thus neither the spicules nor the pigment-cells of the specimen from St. 37, which is regarded as the type, agree perfectly with Sluiter's description, and one can only assume that some of the specimens from other localities were different.

The Barrier Reef specimen differs from the type in the greater quantity of pigment, pigment-cells being found throughout the bladder-cell and spicule layers. This gives the whole colony a darker appearance, the borders being dark grey and the central parts speckled grey and black. In the type the central parts may be grey and black, or white and black, but the borders are always white. No cloacal openings were seen in the Barrier Reef specimen. They are rather conspicuous in the type, being round or oval with a thin border free from spicules and pigment-cells. In the preserved material this border

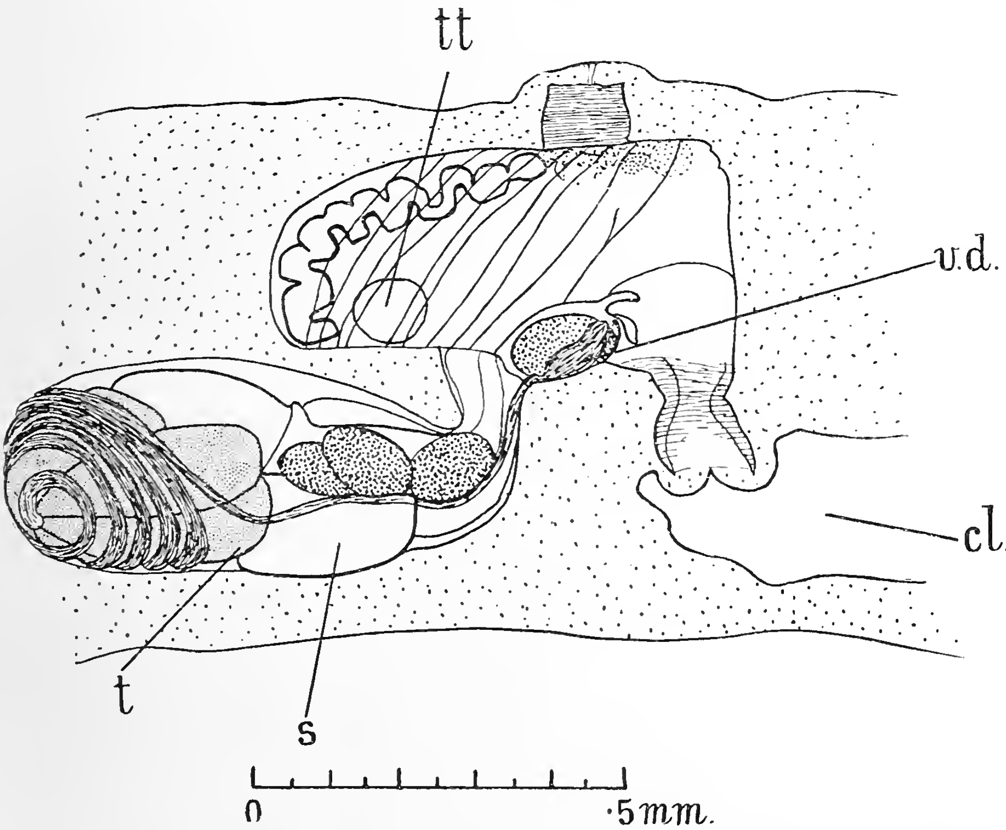
forms a frilled edge to the aperture, but it looks as if it would stand up as a collar in the living animal.

The agreement of this species with Michaelsen's full description of *L. sparsus* leaves me with no doubt that he had the same species.

Leptoclinides lissus sp. n. (Text-fig. 12.)

OCCURRENCE.—St. XVI (1 colony).

This specimen forms a band 3 cm. wide round a worm-tube. It is less than 1 mm. thick, except at a few points where it attains 2 mm. It is smooth, white and opaque.



TEXT-FIG. 12.—One zooid of *Leptoclinides lissus* sp. n. (For explanation of lettering, see footnote, p. 73.)

The zooids are visible to the naked eye as light grey patches. Under considerable magnification the branchial orifices of decalcified and stained pieces can be seen to have lobes of very unequal size, as figured for *L. diemenensis* (Michaelsen, 1924, p. 331), but in a surface view of the undecalcified colony the conspicuous features are three groups of two or three spicules surrounded by a muscular ring. Bladder-cells are rare and do not form a definite layer. The spicules are mostly about ·04–·05 mm. in diameter, regularly stellate with pointed rays. They are rather numerous throughout the zone occupied by the zooids, but are rare in the basal layer. They are very evenly and closely distributed in the surface layer. The abdomen turns sharply sideways (Text-fig. 12), and the atrial siphon is directed downwards to the cloacal canal which runs near the base of the colony. The

siphons are both long, the length varying somewhat, apparently according to the degree of contraction. No vascular processes were seen. The thoracic tubercles are of the form characteristic of *Leptoclinides*. They are ·1–·2 mm. in diameter, and lie near the middle of the posterior end of the thorax. There are about 9 longitudinal muscle-bands on each side of the thorax. The branchial sac has 4 rows of long, oval stigmata and about 12 stigmata in a row. There are about 16 tentacles. As many as 7 testis follicles have been counted and the vas deferens makes 6 turns.

Remarks.—This species belongs to the southern group of species of *Leptoclinides*, differing from the northern *L. faeröensis* Bjerkan in their divided testis. It is very closely allied to *L. diemenensis* Michaelsen (1924, p. 331), only differing in the smoothness, whiteness and opacity of the colony and in the absence of an outer layer of bladder-cells. Probably when more is known of their range of variation these species will be found to be synonymous; at present it seems best to treat them as distinct.

Didemnum candidum Savigny. (Plate II, fig. A; Text-fig. 13.)

Didemnum candidum Savigny, 1816, pp. 14, 194, pl. iv, fig. 3, pl. xx, fig. 1; Hartmeyer, 1915, p. 419, text-figs. 13, 14; Michaelsen, 1919, p. 18; Van Name, 1921, p. 322, figs. 16–18, 20–25; Michaelsen, 1924, p. 358 (synonymy); Van Name, 1924, p. 25.

Distribution.—New Zealand, Indian Ocean, Atlantic.

Occurrence.—Low Isles: Thalamita Flat (pink and white forms), R.C. (pink form), Dredge: St. XIX, XXI, XXII.

Two characteristic specimens of *Didemnum candidum* were dredged growing on a sponge at St. XXI and very small colonies on other Tunicates at St. XIX and XXII. The spicules are stellate and are slightly more numerous in the upper layers. The largest colony is irregular in shape. It measures 5 cm. × 1·5 cm., and is about 1·5 mm. thick. They are all white.

The shore Didemnids of similar type have burr-like spicules with numerous fine rays, such as were found by Van Name (1921) in *D. candidum.* The collector, who was an experienced systematist, found that they were of two clearly defined kinds, differing, among other things, in colour, one kind being white, the other pink. He describes the white colonies as being "generally larger and more winding," and differing in texture. He says that the colours of both were quite constant and did not suggest colour varieties.

In the preserved material the white form is thin. It has fewer spicules in the lower layers. There is a darkly pigmented epithelium over the abdomen and some pigment on the thorax. The cloacal apertures are small and inconspicuous, and in section a few large bladder-cells are seen at the surface. The pink colonies from the Thalamita Flat are small and cushion-like (Plate II, fig. A). The colour is lodged in the test, which is pink, and in the zooids, which are red. The cloacal apertures are rather large and shallow. The specimens of the pink type from R.C. are, however, intermediate. The colonies are thin and white, when preserved, as in the white form, but the spicules are densely distributed throughout as in the pink. The cloacal apertures are slit-like.

No essential difference could be detected in the zooids of any of these colonies. The branchial siphon is broader than high, with six shallow, pointed lobes. The thorax is

about as wide as high with a simple atrial opening. The thoracic tubercle is external and lies at about the level of the third row of stigmata. The branchial sac has four rows of stigmata, and about eight stigmata in a row. There is a pointed retractor which is not attached to the neck. The œsophagus is sharply constricted at about the middle of the neck. The abdomen is slightly larger than the thorax. There is a more or less oval stomach. The intestine is in three sections, separated by constrictions. The first (" nachmagen ") is cylindrical, with a sudden expansion behind. The second (" drusenmagen ") is oval and the third long and slightly tapering. The rectum is thin-walled. The ovary and testis lie beside the intestine. The testis consists of a single follicle, round which the vas deferens makes five turns.

Such differences in the zooids as exist appear to depend either on the thickness of the colony or on the state of contraction of the digestive tube. In thin colonies the abdomen is turned sharply to one side, while in thick ones it hangs straight down. The stomach may have both cardiac and pyloric inpushings, or one only, or neither, and the parts of the intestine may be wide or narrow. These differences may appear in the same colony (Text-fig. 13). In the zooids from the pink form the thoracic tubercles are slightly more conspicuous and more stalked than in the other specimens, but the whole thorax is less shrivelled, so the difference is probably only apparent.

Superficially, the pink form might be thought to be *L. densum* Nott (1892, p. 311). This species differs, however, in the spicules, whose rays are few and very blunt, in the longer branchial siphon and in the divided testis. Michaelsen (1924, p. 354) re-discovered Nott's species and confirmed these characteristics. He regards *D. densum* as synonymous with *D. albidum* (Verrill, 1871, p. 446).

To sum up, the shore specimens attributed to *D. candidum* all differ from the dredged specimens in their burr-like spicules. When alive they fell into two groups, distinguished by colour, texture, etc., but the only character which constantly distinguishes these same groups in preserved material is the distribution of spicules. These are less numerous in the lower layers of the white group and uniformly dense throughout in the pink. The zooids are very similar in all. They all fall within the range of variation attributed to *D. candidum* by Van Name (1921), and Michaelsen (1924) expresses his agreement with Van Name's view. On the other hand, a species (*D. densum*), somewhat resembling the pink form externally, differs in internal structure.

At present, therefore, there seems to be no alternative but to treat all the Barrier Reef specimens as one species. The observations on the living material are, however, of great importance, and point to the existence of differences which are not expressed by the present systematic treatment of the Didemnidae.

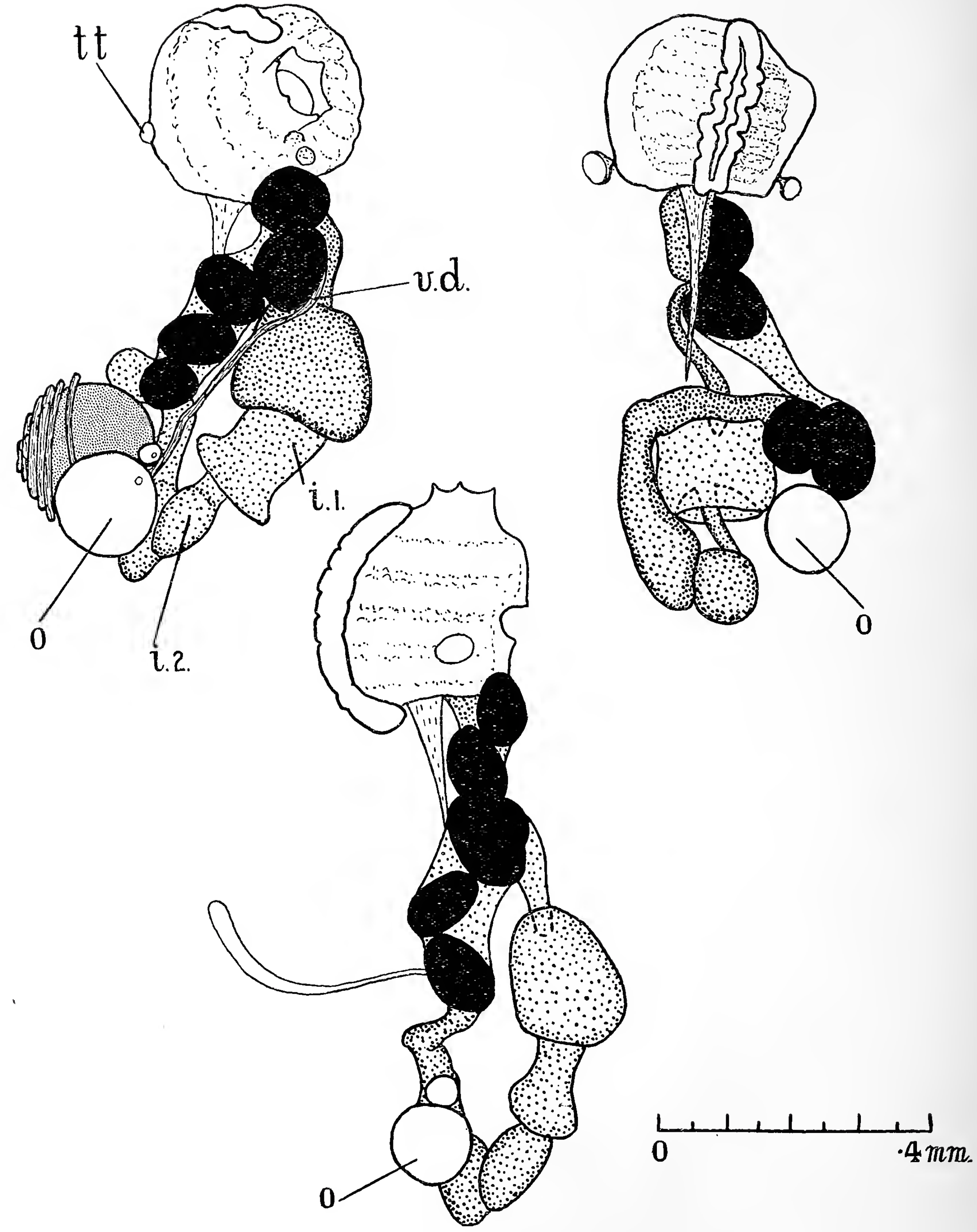
Didemnum psamathodes var. *skeati* (Sollas).

Hypurgon skeati Sollas, 1903, p. 729, pls. xxxiv, xxxv.
Didemnum psammatodes var. *skeati* Michaelsen, 1920, pp. 22, 27 (synonymy).

Distribution.—Malaya, Indian Ocean, Gold Coast ?

Occurrence.—Thalamita Flat.

These specimens correspond to Sollas' description of var. *skeati*. They differ from the typical form of Sluiter (1895, p. 171) in having a cluster of spicules round each branchial opening, and few, if any, in the rest of the test.



TEXT-FIG. 13.—*Didemnum candidum* Savigny (pink form). Three zooids from the same colony. (For explanation of lettering, see footnote, p. 73.)

Didemnum voeltzkowi Michaelsen.

Didemnum voeltzkowi Michaelsen, 1920, p. 54, text-fig. 6.

Distribution.—Madagascar.

Occurrence.—Sand Flat, A4.

These specimens agree in most points with Michaelsen's description of *D. voeltzkowi*. The spicules are uniformly and densely distributed except in the region of the lowest cloacal canals, where they may be slightly less numerous. No central cavity was seen in them. The colonies from A4 are encrusting. Those from the Sand Flat are rather large irregular pieces with a smooth white basal surface which appears only to have been attached here and there. The largest measures 60 mm. × 30 mm. The zooids are very well expanded and are 1·5 mm. long. The branchial aperture is not lobed. The anus is beside the posterior end of the thorax. Otherwise their agreement with Michaelsen's description is exact.

The spherical bodies described by Michaelsen are very numerous round the branchial sac. Dr. C. M. Yonge finds that they are zooxanthellae. The general arrangement is that shown by Michaelsen (1920, p. 52, Text-fig. 5) in *D. bistratum*, but the zooxanthellae tend to be arranged in a single layer on the surface of the branchial sac and its projecting laminae, and they may be so numerous as to fill the rectangular spaces formed by these laminae as seen in cross-section. Dr. Yonge finds that the zooxanthellae are not of the same kind as those in *Diplosoma virens*.

D. voeltzkowi was found at Madagascar. Two species (*L. bistratum* Sluiter, 1905, p. 18, and *D. patella* Gottschaldt, 1898, p. 651) of the *D. bistratum*-group of Michaelsen (1920) are known from Malaya, but they do not agree with the Australian specimens as closely as does *D. voeltzkowi*.

D. voeltzkowi superficially resembles *Leptoclinum tonga* Herdman (1886, p. 269), from Tongatabu. They agree in the shape of the colony, the absence of bladder-cells and the distribution of spicules, in the long thorax with four rows of long stigmata and the relatively short round abdomen, and in the position of the thoracic tubercles. Examination of Herdman's type shows that they differ in many ways. In *L. tonga* the surface of the colony is smooth. There are no cloacal canals below the zooids. The spicules have fewer longer rays (Herdman, pl. xxxv, fig. 4). Each zooid has a very long retractor, extending beyond the abdomen for more than the length of the whole zooid. The zooids are much less numerous. The atrial opening is not remarkably extensive, and there are no zooxanthellæ. The testis is slightly lobed, and the vas deferens makes five turns round it.

Didemnum chartaceum Sluiter. (Text-fig. 14 a, b.)

Didemnum chartaceum Sluiter, 1909, p. 57.

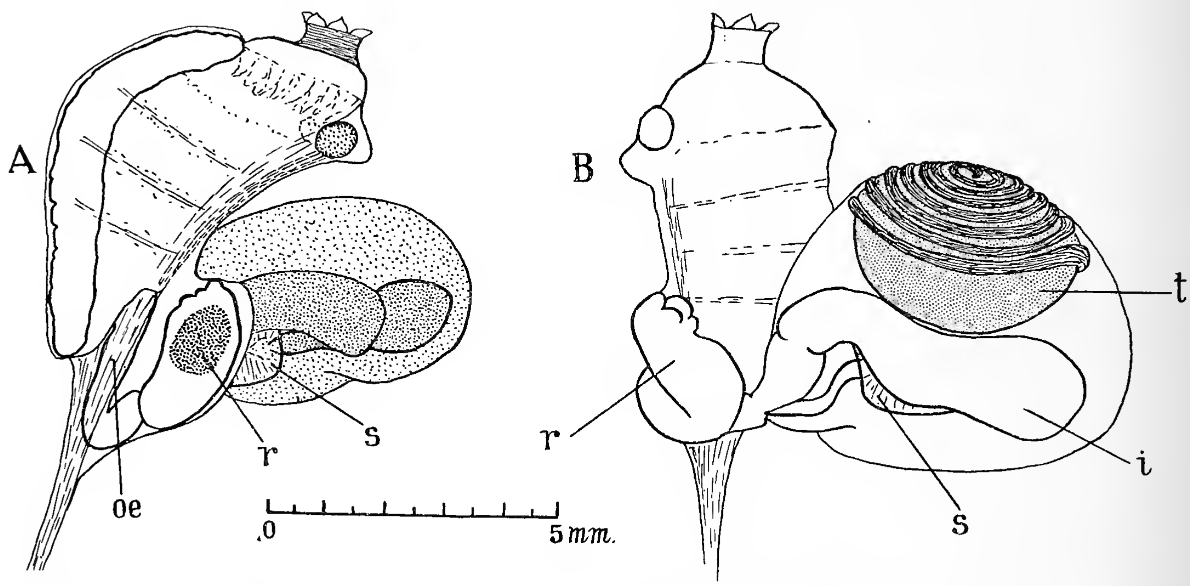
Distribution.—Flores (Siboga, St. 50).

Occurrence.—St. XVI (1 colony).

This colony covers the back of a small Dromiid crab, only leaving the ventral surface and appendages free. It is 2·5 mm. thick at the thickest point. The zooids are evenly

distributed and show as darker patches on the surface. There are three shallow, round cloacal apertures, conspicuous owing to the absence of spicules in their floor. The surface layer consists of bladder-cells. Below this there is a thin layer of closely placed spicules. The main thickness of the test consists of bladder-cells and the basal layer contains some spicules, but they are not so thickly distributed as in the upper spicule layer. The spicules have rather numerous blunt rays and the majority are ·03 mm. in diameter.

The zooids occupy the upper half of the colony, but their retractors extend straight down into the lower half and may nearly reach the base. There are knobbed vascular processes. The abdomen is slightly larger than the thorax and placed at right angles to it. The branchial siphon is about as wide as high and has six small pointed lobes. The atrial opening is a simple hole. The thorax has longitudinal muscle-bands, the strongest of which are dorsal, and there are transverse muscles over the transverse bars. There are four



Text-fig. 14.—*Didemnum chartaceum* Sluiter. Two views of zooids from the type-specimen. A, Seen from the left. Abdomen shaded. B, Composite drawing of a zooid seen from the right. (For explanation of lettering, see footnote, p. 73.)

rows of stigmata. The dorsal languets are large. The thoracic tubercles contain large quantities of spicules and are very conspicuous in undecalcified material. They occupy the middle of each side of the thorax and project outwards. The testis consists of one large follicle, round which the vas deferens makes eight turns. It lies beside the intestinal loop.

Examination of the type of *D. chartaceum* (Text-fig. 14 A, B) shows that it agrees very closely with this specimen. It differs in the form of the colony, which in the Barrier Reef specimen is clearly related to its position on the back of a crab. No vascular processes were seen in the type, and it differs in colour. The tissues of the Barrier Reef colony are of a reddish-purple colour, of such persistence and intensity that unstained microscopic preparations have all the appearance of having been stained. It does not look like a natural pigmentation, for it is diffused through all the tissues both of zooids and test.

The crab and some sponges from the same bottle are the same colour, and the original label is somewhat stained. All these points lead me to suspect that the colour is derived from some other organism bottled with them.

Didemnum jedanense Sluiter.

Didemnum jedanensis, Sluiter, 1909, p. 59.

DISTRIBUTION.—Malaya.

OCCURRENCE.—St. XII (1 colony on a Gastropod), XIX (1 colony on weed).

I have examined original material of this species from three of the four stations at which it was obtained. All agree in having a surface layer of bladder-cells without spicules, and below this a zone with spicules, the spicules becoming less numerous basally where there are many bladder-cells. They all have pigment-cells in the upper layers, giving a streaked or mottled appearance to the colony as a whole. The pigment is purplish brown in spirit. The cloacal system is chiefly at the level of the thorax, but has channels extending between and below the zooids. The zooids have a rather large abdomen and a long retractor, extending beyond the end of the abdomen. The thorax has musculature on the transverse bars, a pair of strong longitudinal muscle-bundles on the dorsal edge, and fine longitudinal strands over the rest.

In other ways there is a certain amount of difference between the specimens. The specimen from St. 303 shows certain peculiarities which I interpret as signs of old age in the colony. The vas deferens appears to be degenerating. It is inflated and composed of rather coarse, deeply-staining tissue, and only forms one turn. No trace of the testis can be seen. The test contains excretory granules and fæcal pellets in its lower layers and much pigment throughout. There are very few zooids and the cloacal system is of correspondingly small extent. The spicules are large with many blunt rays.

The specimens from the other two localities are therefore more important representatives of the species and I choose that from St. 89, the first on Sluiter's list, as the type. It differs from that from St. 273 in its rather smaller spicules with more numerous, finer rays. The spicules from St. 273 are larger, some being as much as ·03 mm. in diameter, and very regularly stellate. In the type the pigment-cells are elongate and distributed throughout the zooid-containing region of the test. In the specimen from St. 273 they are more or less round and only found in the bladder-cell layer. The zooids are visible as grey dots at the surface of the colony from St. 273, and are less conspicuous in the type. Some zooids in the type are well expanded and the thorax then appears considerably longer than broad, with large stigmata. More contracted zooids do not differ noticeably from those from other specimens. The vas deferens makes 6–8 turns round the testis, which may be flat or spherical in different zooids of the same colony. Vascular processes with knobbed ends have been seen in the type, but not in the specimen from St. 273.

Two specimens from the Barrier Reef agree with these specimens in the presence of pigment-cells, the distribution of bladder-cells and spicules, the tridimensional cloacal system, the general form of the zooids, the long retractor and the musculature of the thorax. One (St. XII) resembles the type in its inconspicuous zooids. The other, like that from St. 273, has zooids clearly visible as dots on the surface. This specimen has large spherical pigment-cells, ·05 mm. in diameter, with the pigment-granules arranged

peripherally. They appear distinctive, but the other specimen shows gradations between these and the smaller, less regular ones of the specimen from St. 273. The spicules are rather smaller than those of any of the original specimens. A few are ·025 mm. in diameter, but most are smaller. They have rather numerous fine rays. Knobbed vascular processes are present in the specimen from St. XIX, but have not been seen in that from St. XII. The differences, both here and in the types, in the occurrence of vascular processes may depend on the part of the colony cut, as they were only seen at the edge. No gonads were seen.

This species as understood by Sluiter has a considerable range of variation which covers the characteristics of the Barrier Reef specimens, and it has seemed best to identify them with it for the present.

Didemnum (*Polysyncraton*) *magnetae* sp. n. (Text-fig. 15).

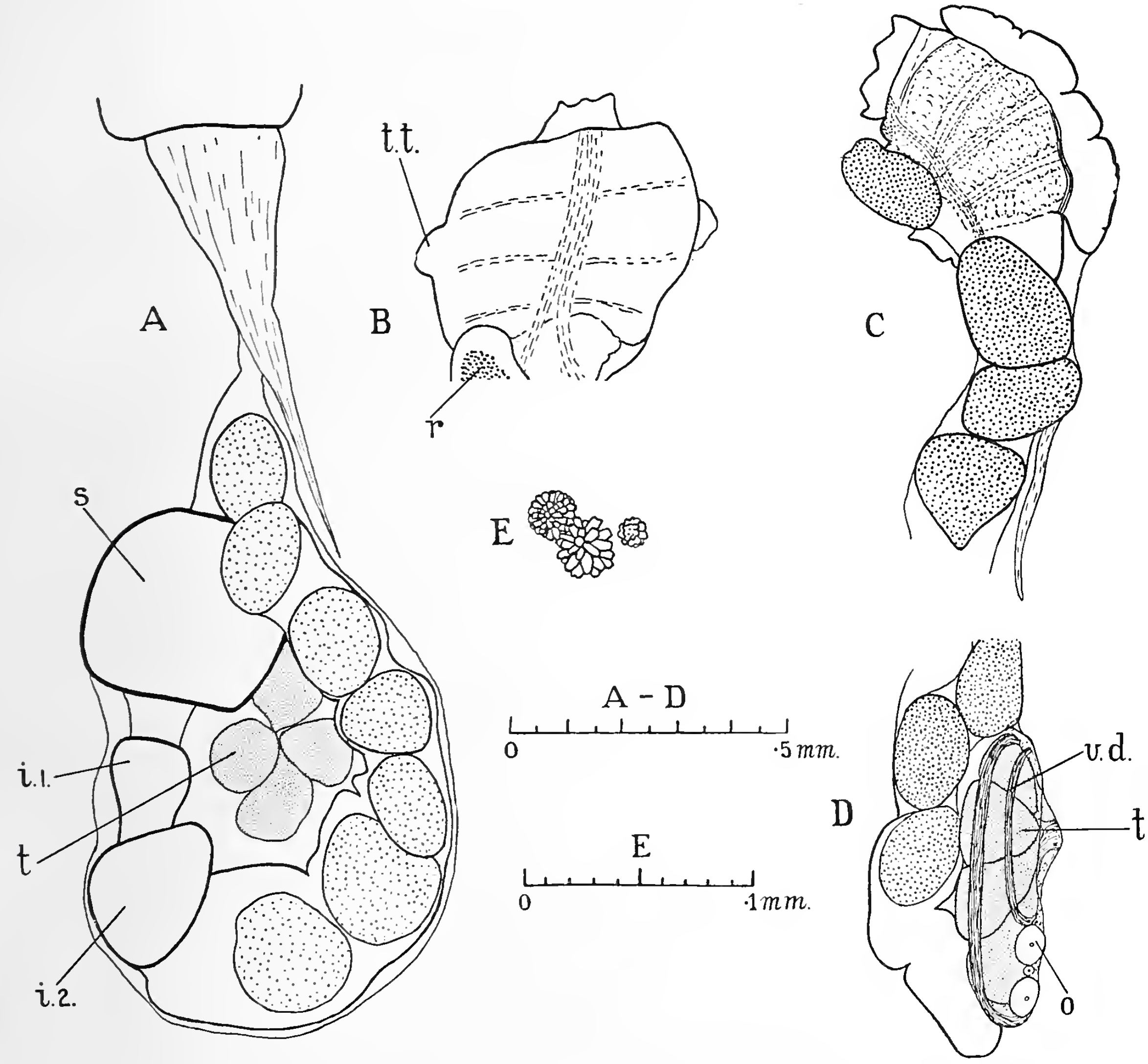
Occurrence.—St. XXIII (1 colony).

The colony appears to have been loosely attached to an irregular substratum. It is, on the average, 3 mm. thick, and of flexible, leathery consistency. The zooids are yellowish grey. They are arranged in double rows, which form a network over the surface of the colony, conspicuous to the naked eye. The surface areas between the rows of zooids contain many spicules and are white and slightly prominent. There are two conical projections of the surface of the colony, each with a rather large, round aperture at the summit. One contains a tube of fine mud which was presumably made by some commensal animal, but is now empty. The other contains shell fragments, etc. The hollow centres of these cones are traversed by strands of test containing scattered spicules. No other cloacal apertures were seen.

In vertical section the thin layer of test above the cloacal canals is seen to contain spicules and bladder-cells in quantities varying according to the region cut. In some parts there is a definite layer of spicules here. Below the cloacal canals, and forming their floor, is a thin layer of densely packed bladder-cells, free from spicules. Spicules are most densely packed just below this layer. They become rather less numerous towards the basal surface and some bladder-cells are found. There is a thin basal layer with many spicules, giving a smooth, white under-surface. No pigment-cells have been seen. There are clusters of excretory granules in the lower layers, and in many parts of the test faecal pellets are very numerous (" Hypurgon-condition "). The largest spicules are less than ·03 mm. in diameter. They have rather numerous blunt rays (Text-fig. 15 E).

The zooids are about 1·5 mm. long. The abdomen forms nearly half this length and the neck is nearly as long as the thorax. The neck is usually constricted just behind the middle. The retractor varies in length, but never extends beyond the abdomen. The extent to which it is attached to the neck is very variable. One or more vascular processes may spring from the posterior end of the neck, and may have knobbed ends. The branchial siphon is much broader than long when relaxed, slightly longer than broad when contracted (Text-figs. 15 B, C). The upper and lower edges of the atrial opening are more prominent than the sides. There are longitudinal thoracic muscle-bands, of which the most conspicuous on each side is dorsal (Text-fig. 15 B, C), and there are muscles on the transverse bars. There are 4 rows of stigmata, and about 10 in a row, but accurate counting is impossible. The dorsal languets are large. The thoracic tubercle lies over

the second row of stigmata, rather nearer the dorsal than the ventral edge of the thorax. It projects into the test and appears to have a small round aperture at its apex (Text-fig. 15 B). The alimentary canal forms a long narrow loop (Text-fig. 15A). The stomach is large and its long axis is placed longitudinally. The first two sections of the intestine are directed straight backwards. The second section is thicker-walled than the first, and after it the intestine turns sharply forward. The gonads are beside the intestinal loop (Text-fig.



TEXT-FIG. 15.—*Didemnum* (*Polysyncraton*) *magnetae* sp. n. A, Neck and abdomen. B, Dorsal view of thorax. C, Thorax seen from the right. D, Tip of abdomen. E, Spicules. (For explanation of lettering, see footnote, p. 73.)

15D). The testis consists of 5–7 follicles, more or less closely packed according to their size. The vas deferens makes $1\frac{1}{2}$–2 turns. The ovary lies close to the testis on its outer surface.

Remarks.—This species is allied to *P. tubiporae* Michaelsen (1920, p. 9). They resemble each other in the arrangement of the zooids, the general structure of the test, and the size and shape of the spicules. Both have a layer of test which is free from spicules

below the cloacal canals. The zooids are similar in size and shape, the proportions of thorax, neck and abdomen being characteristic. In both the testis is in the intestinal loop, with the ovary closely pressed to its outer surface. *P. magnetae* differs from *P. tubiporae* in the following points : There is no outer layer of bladder-cells, but this may have been lost, the colony having a rather worn appearance. The thoracic tubercles project outwards and have a small round aperture. The intestine is definitely divided into sections. The vas deferens only makes $1\frac{1}{2}$–2 turns round the testis.

Diplosoma spongiforme (Giard) var. ? Michaelsen.

Diplosoma spongiforme var.? Michaelsen, 1930, p. 529.

Distribution.—S.W. Australia, Indian Ocean ?

Occurrence.—St. XIX (1 colony).

This specimen is a true *Diplosoma* of the *D. spongiforme* type. The colony is dappled black and light brown, owing to the presence of black pigment in the body-wall of some groups of zooids and its absence from others. In the pigmented zooids both thorax and abdomen are black and consequently opaque.

There can be very little doubt that this specimen belongs to the same species as Michaelsen's from S.W. Australia, but, as he has pointed out, it is at present impossible to determine its relationship to *D. spongiforme* and other similar forms.

Diplosoma virens (Hartmeyer). (Plate III, figs. A and B ; Text-fig. 16.)

Leptoclinum virens Hartmeyer, 1909, p. 1456, nom. n. for
Diplosoma viride Herdman, 1906, p. 341, pl. viii, figs. 34–40, pl. ix, fig. 6.
non *Leptoclinum viride* Herdman, 1906, p. 340.

Distribution.—Ceylon.

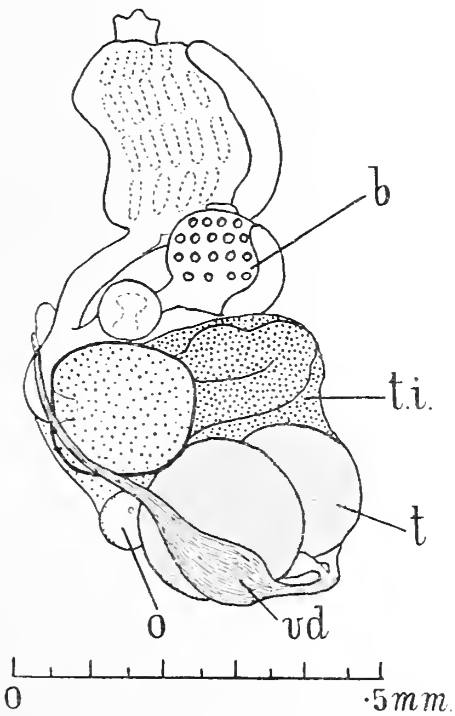
Occurrence.—Low Isles : G1, G3, F9, Reef Flat between F11 and IR1, IM1, Mangrove Park. Three Isles : Anchorage. Batt Reef : Patch No. 1.

After examination of the type material of *D. virens* (B.M. 07.8.30.42) some additions can be made to Herdman's description. There is a thin layer of test within the layer of bladder-cells and the centre of the colony is crossed by strands of test ("loose, lacunar test" of Herdman). The spherical green cells (Plate III, fig. A, *z.*) are only found in the spaces, not embedded in the test, and tend to be arranged in a single layer on the surface of the strands of test. It is, no doubt, the layer of these cells on the inner surface of the continuous layer of test that gives the optical effect of a dark green ring outside the zooids, which is mentioned by Herdman. The green cells are very numerous. The zooids, with a thin coating of test, are slung across the central cavity of the colony, only the branchial siphon being embedded in the main part of the test. The thorax in adult zooids is longer than in Herdman's figs. 39 and 40, which evidently represent young zooids. The stigmata, which are round in the buds, are fairly long in the adult. The constriction between thorax and abdomen is rather long. There is the usual bifid testis, with uncoiled vas deferens, which is dilated soon after leaving the testis.

Several congregations of small colonies from the Barrier Reef have been identified with Herdman's species. In life they were conspicuous for their green or blue colour.

Dr. C. M. Yonge has examined some of them, and finds that the spherical bodies are zooxanthellae. He thinks that the blue and green colours of the living colonies may be due to the combined effect of varying proportions of the yellow or brown colour of the zooxanthellae and a blue colour, presumably in the test. The green colour of these colonies would therefore not be of the same nature as that of the type-specimen, in which, according to Herdman, the algal cells were green. In the colonies from Ceylon with reddish-brown cells (*Diplosoma* sp. Herdman, 1906, p. 342) the general colour was reddish brown, not green. Dr. Yonge finds that the algal cells of the type are a different species from those in the Barrier Reef specimens.

Each colony has a single cloacal aperture. The specimens agree with *D. virens* in



TEXT-FIG. 16.—*Diplosoma virens* (Hartmeyer). Zooid from Barrier Reef. (For explanation of lettering, see footnote, p. 73.)

forming small, loosely-attached colonies with the test drawn out into processes, in having numerous bladder-cells in the outer layer of the test, in having their central cavities more or less filled with algal cells, in the shape and distribution of the vascular processes, and in the form of the zooids (Text-fig. 16).

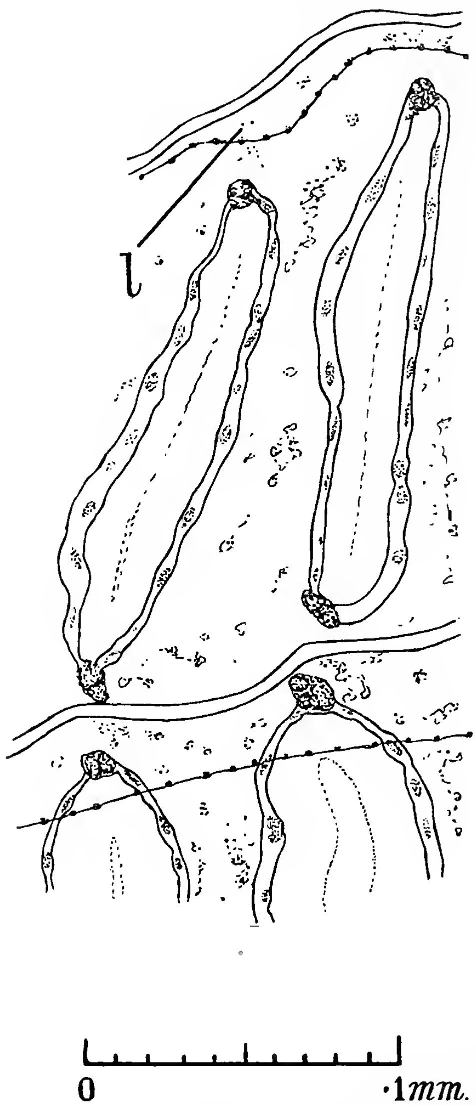
The chief difference is that in the Barrier Reef specimens strands of the test extending into the central cavity are not common, and are short and thick (Plate III, fig. B). There are differences in the main part of the test which may be due to less contraction in preservation, the bladder-cells being less closely packed and the inner layer being thicker and less dense. In the type this layer has a slightly striated appearance (*cf.* Plate III, figs. A and B).

Only three species of *Diplosoma* have been recorded from Australia, namely *D. rayneri* Macdonald (1859, p. 373), *Leptoclinum* (*Diplosoma*) *translucidum* Hartmeyer (1910, p. 1490) = *L. perspicuum* Sluiter (1909, p. 79), *D. spongiforme* var.? Michaelsen

(1930, p. 529). The two latter are clearly distinct from the present specimens, but *D. rayneri*, which was found at Port Jackson and has not been recorded since, agrees as far as its description goes. No mention is made, however, of any of the specific peculiarities of *D. virens*, some of which it is unlikely that Macdonald would have overlooked.

Diplosomoides ostrearium Michaelsen. (Text-fig. 17.)

Diplosomoides ostrearium Michaelsen, 1930, p. 526.



TEXT-FIG. 17.—*Diplosomoides ostrearium* Michaelsen. Stigmata seen from the inner surface of the branchial sac. Cilia omitted, the position of their tips indicated by dotted line. *l.*, lamina on transverse bar.

DISTRIBUTION.—Oyster Harbour, S.W. Australia.

OCCURRENCE.—Mangrove Park, on *Cymodocea*.

Two small colonies, the largest 7 mm. × 4 mm., agree with Michaelsen's description. Like his specimens, they are growing on a linear leaf. They are described as purple when alive. The branchial sac is large and very delicate. The stigmata are large, and the

bars between them as wide as the stigmata. The epithelium on the stigmata consists of very flat cells with oval nuclei, and there are large, round cells in the angles (Text-fig. 17). A transparent membrane (*l*) projects inward from each transverse bar and has a row of nuclei in its edge. The thoracic tubercles are nearer to the endostyle than to the dorsal lamina. No reproductive organs were seen.

Michaelsen states that his species may be identical with one of the Malayan species of Gottschaldt or with *D. molle* Herdman (1886, p. 310). Examination of the type of *D. molle* (B.M. 87.2.4.446) shows that it is distinct. As in the specimens subsequently attributed to the species, there is a large, round cloacal opening at the summit of the more or less conical colony. The spicules are slightly more numerous in the surface layer than in *D. ostrearium*, and they are not found in the layer of test surrounding the zooids, except in the region of the thoracic tubercle. Their surface while in the tubercle is smoother than in those in the same position in *D. ostrearium*. These groups of spicules were not seen by Herdman (1891, p. 633). The tubercles themselves resemble those of *D. ostrearium* in form and position. The branchial sac is longer, being nearly twice as long as wide, and is not so delicate as that of the present specimens. The stigmata have the usual type of epithelium. The tentacles are thicker and less numerous. There is a pair of longitudinal muscles, mentioned by Herdman, on the dorsal edge of the thorax. They are continued into a retractor of unusual length, which, extending for a considerable distance beyond the abdomen, is conspicuous in the test. *D. ostrearium*, on the other hand, is without retractors.

Polyclinum macrophyllum subsp. *phortax* Michaelsen.

Polyclinum macrophyllum subsp. *phortax* Michaelsen, 1930, p. 546.

Distribution.—Shark's Bay, W. Australia.

Occurrence.—St. XXIII (1 colony).

This colony corresponds closely with Michaelsen's description. As in subsp. *typicum* the post-abdomen lies beside the abdomen, but, as pointed out by Michaelsen, this depends on the thickness of the colony. There is a wide cavity between the mantle and the branchial sac, traversed by conspicuous vessels which join the transverse vessels of the branchial sac. Zooids with a row of small, irregular stigmata were seen, and this row was not always the most posterior. The cloacal opening is bordered by finger-like processes occupied by parts of the tips of the atrial languets as figured by Michaelsen (1930, p. 54) in *P. constellatum*. There is a short atrial siphon.

THALIACEA AND APPENDICULARIA.

The details of the distribution of these groups of Tunicata will be found in Dr. Russell's report on the Plankton and, as the specimens call for no comment, it is sufficient to give a list of the species and a selection of references to the literature. *Megalocercus huxleyi* is only known from the Indo-Pacific region (Ihle, 1929). The other species are very widely distributed, being found, at least in the warmer waters, in the Atlantic, Pacific and Indian Oceans.

The absence of *Oikopleura cophocerca* is rather surprising. It was found, with the three species here recorded, on the S.W. coast of Australia (Lohmann, 1909, p. 144) and

in the Malayan region (Ihle, 1908, p. 118). A rather large proportion of the specimens of *Oikopleura* are unfit for certain identification, but there is no reason to suppose that there are among these any species not represented by those better preserved. Three individuals of *O. rufescens* had the more horizontal rectum described by Ihle (1908, p. 114).

Cyclosalpa pinnata (Forskål).

Salpa pinnata Forskål, 1775, p. 113.
Cyclosalpa pinnata Metcalf, 1918, p. 9, text-figs. 1–14, pls. i, ii (synonymy).

Salpa democratica Forskål.

Salpa democratica Forskål, 1775, p. 113.
Thalia democratica Sewell, 1926, p. 92, text-figs. 20–26 (synonymy).

Salpa zonaria (Pallas).

Holothurium zonarium Pallas, 1774, p. 27, pl. i, fig. 17 A, B, C.
Jasis zonaria Sewell, 1926, p. 88, text-figs. 18, 19 (synonymy).

Salpa cylindrica Cuvier.

Salpa cilindrica Cuvier, 1804, p. 381, pl. lxviii, figs. 8, 9.
Salpa cylindrica Sewell, 1926, p. 77, text-figs. 7–13 (synonymy).

Salpa confoederata Forskål.

Salpa confoederata Forskål, 1775, p. 115.
Pegea confoederata Sewell, 1926, p. 100, text-figs. 28–33. (synonymy.)

Salpa rostrata Traustedt.

Salpa rostrata Traustedt, 1893, p. 8, pl. i, figs. 1–4 ; Apstein, 1894, p. 16, pl. ii, figs. 9, 10, 17–22, text-fig. ix ; Ihle, 1910, p. 27, pl. i, fig. 17.
Brooksia rostrata Metcalf, 1918, p. 50, text-figs. 22–24.

Doliolum denticulatum Q. & G.

Doliolum denticulatum Quoy & Gaimard, 1834, p. 599, pl. lxxxix, figs. 25–28 ; Neumann, 1906, p. 222, pl. xxiv, fig. 1 (development, pp. 100–206, figs.) ; Ihle, 1910, p. 15.

Doliolum tritonis Herdman.

Doliolum denticulatum Herdman, 1887, p. 101, pls. xviii–xx.
Doliolum tritonis Herdman, 1888, p. 47, pl. iii, fig. 3 ; Neumann, 1906, p. 220 ; Ihle, 1910, p. 14.

Asexual Doliolum.

Asexual specimens of *Doliolum* are not abundant in the collection, and the species of none of those found could be identified.

Fritillaria haplostoma Fol.

Fritillaria aplostoma Fol, 1872, p. 478, pl. vi, fig. 6.
Fritillaria haplostoma Lohmann 1896, p. 39, pl. v, figs. 1–3, 6 ; Ihle, 1908, p. 93 ; Essenberg, 1926, p. 442, text-figs. 52–56.

Oikopleura longicauda (Vogt).

Appendicularia longicauda Vogt, 1854, p. 74, pl. x, figs. 4–6.
Oikopleura longicauda Lohmann, 1896, p. 59, pls. ix, x, fig. 7 ; 1901, p. 19, text-fig. 23; Ihle, 1908, p. 111, pl. iii, figs. 40–43 ; Essenberg, 1926, p. 487, text-figs. 130–132.

Oikopleura fusiformis Fol.

Oikopleura fusiformis Fol, 1872, p. 473, pl. iii, figs. 5–8 ; Lohmann, 1896, p. 63, pl. xvi, fig. 3, pl. xvii, figs. 5, 7, 8 ; 1901, p. 20, text-fig. 24 ; Ihle, 1908, p. 113 ; Essenberg, 1926, p. 494, text-figs. 140–142.

Oikopleura rufescens Fol.

Oikopleura rufescens Fol, 1872, p. 471, pl. x, fig. 3 ; Lohmann, 1896, p. 74, pl. xvi, figs. 2, 4, pl. xvii, figs. 1–3, 6 ; Ihle, 1908, p. 114, pl. iv, figs. 69–73 ; Essenberg, 1926, p. 491, text-figs. 136–139.

Stegosoma magnum (Langerhans).

Oikopleura magna Langerhans, 1880, p. 145, pl. vi, fig. 73.
Stegosoma magnum Lohmann, 1896, p. 79, pl. xviii ; Ihle, 1908, p. 115 ; Essenberg, 1926, p. 505, text-figs. 154–158.

Megalocercus huxleyi (Ritter & Byxbee).

Oikopleura huxleyi Ritter & Byxbee, 1905, p. 206, pl. ii, figs. 9–11.
Megalocercus huxleyi Ihle, 1908, p. 98, pl. i, fig. 1–8, pl. ii, figs. 9–13, 16–22, pl. iii, figs. 31, 32, 37–39, text-figs. 9, 10 ; Lohmann, 1914, p. 353, text-figs. 1, 2*a*, 3*a* and *c*, 4*a*, 5, 6*a*.

REFERENCES.

Apstein, C. 1894. Die Thaliacea der Plankton-Expedition. B. Vertheilung der Salpen. Henson, V. Ergebn. Plankton-Exp. IIE. a.B., pp. 68, 1 pl., 2 maps, text illust.

Ärnbäck-Christie-Linde, A. 1923. Northern and Arctic Invertebrates in the Collection of the Swedish State Museum. Tunicata II, Botryllidae. K. svenska VetenskAkad. Handl. LXIII, no. 9, pp. 1–25, 1 pl., 8 text-figs.

Cuvier, G. 1804. Sur les Thalides (*Thalia*, Brown), et sur les Biphores (*Salpa*, Forskaohl.). Ann. Mus. Hist. nat. Paris, IV, pp. 360–382, 1 pl.

Essenberg, C. E. 1926. Copelata from the San Diego Region. Univ. Calif. Pub. Zool. XXVIII, pp. 399–521, 170 text-figs.

Fol, H. 1872. Études sur les Appendiculaires du Détroit de Messine. Mém. Soc. phys. Genève, XXI, pp. 445–499, 11 pls.

Forskål, P. 1775. Descriptiones Animalium, pp. 164, 1 map.

Gottschaldt, R. 1898. Synascidien von Ternate. Abh. senckenb. naturf. Ges. XXIV, pp. 641–660, 2 pls.

Hartmeyer, R. 1907. Ein Beitrag zur Kenntnis der japanischen Ascidienfauna. Zool. Anz. Leipzig, XXXI, pp. 1–30, 12 text-figs.

—— 1909–11. Tunicata. Bronn. Tier-reichs. III suppl., pp. 1280–1773, 41 pls.

—— 1912. Die Ascidien der Deutschen Tiefsee-Expedition. Wiss. Ergebn. Deutsch. Tiefsee-Exp. XVI, hft. 3, pp. 225–392, 8 pls., 10 text-figs.

—— 1913. Tunicata. Forschungsreise W. & Zentr. S. Afrika, V, lief, 2. Denkschr. med.-naturw. Ges. Jena, XVII, pp. 127–144, 2 pls., 6 text-figs.

HARTMEYER, R. 1915. Über einige Ascidien aus dem Golf von Suez. SitzBer. Ges. naturf. Fr. Berl. 1915, no. 9, pp. 397–430, 14 text-figs.

—— 1919. Ascidien. Res. Swed. Sci. Exp. Australia, XXV. K. svenska VetenskAkad. Handl. LX, no. 4, pp. 1–150, 2 pls., 23 text-figs.

—— 1927. Zur Kenntnis phlebobranchiater und diktyobranchiater Ascidien, Mitt. Zool. Mus. Berlin, XIII, pp. 159–196, 18 text-figs.

—— and MICHAELSEN, W. 1928. Ascidiae Diktyobranchiae und Ptychobranchiae. Michaelsen, W., and Hartmeyer, R. Fauna Südwest Australiens, V, lief. 6, pp. 253–460, 61 text-figs.

HELLER, C. 1878. Beiträge zur nähern Kenntniss der Tunicaten. SitzBer. Akad. Wiss. Wien, LXXVII, abt. 1, pp. 83–110, 6 pls.

HERDMAN, W. A. 1882*a*. Preliminary Report on the Tunicata of the " Challenger " Expedition. III, Cynthiadae. Proc. Roy. Soc. Edinb. XI, pp. 52–88.

—— 1882*b*. Report on the Tunicata . . . I. Ascidiae Simplices. Rep. Zool. Chall. Exp. VI, part 17, pp. 293, 37 pls., 23 text-figs.

—— 1886. Report on the Tunicata . . . II. Ascidiae Compositae. Rep. Zool. Chall. Exp. XIV, part 38, pp. 429, 49 pls., 15 text-figs., 1 map.

—— 1887. Report on the Tunicata Collected during the Cruise of H.M.S. " Triton." . . . Trans. Roy. Soc. Edinb. XXXII, pp. 93–117, 5 pls.

—— 1888. Report on the Tunicata . . . III. Rep. Zool. Chall. Exp. XXVII, part 76, pp. 163, 11 pls., 28 text-figs.

—— 1891. A Revised Classification of the Tunicata. J. Linn. Soc. Zool. XXIII, pp. 558–652.

—— 1899. Descriptive Catalogue of the Tunicata in the Australian Museum, Sydney, N.S.W. Cat. Austr. Mus. XVII, pp. xviii, 139, 45 pls.

—— 1906. On the Tunicata. Roy. Soc., London. Rep. Pearl Oyster Fisheries Manaar, Suppl. Rep. XXXIX, pp. 295–348, 9 pls.

HUNTSMAN, A. G. 1913. The Classification of the Styelidae. Zool. Anz. Leipzig, XLI, pp. 482–501, 13 text-figs.

IHLE, J. E. W. 1908. Die Appendicularien der Siboga-Expedition. Weber, M. C. W., Rep. Siboga Exp. LVI*c*, pp. 123, 4 pls., 10 text-figs.

—— 1910. Die Thaliaceen der Siboga-Expedition. Weber, M. C. W., Rep. Siboga Exp. LVI*d*, pp. 55, 1 pl., 6 text-figs.

—— 1929. Über *Megalocercus diegensis* Essenberg. Zool. Anz. Leipzig, LXXXV, pp. 333–335.

LANGERHANS, P. 1880. Über Madeiras Appendicularien. Z. wiss. Zool. Leipzig, XXXIV, pp. 144–146, 1 pl.

LOHMANN, H. 1896. Die Appendicularien der Plankton-Expedition. Hensen, V., Ergebn. Plankton-Exp. II, E. c., pp. 148, 24 pls.

—— 1901. Appendicularien. Brandt, K. A. H., Nord. Plank. Zool. II, pp. 11–29, 16 text-figs.

—— 1909. Copelata und Thaliacea. Michaelsen, W., and Hartmeyer, R., Die Fauna Südwest Australiens, II, lief. 10, pp. 143–149, 1 text-fig.

—— 1914. Die Appendicularien-Gattung *Megalocercus*. Jahrb. Hamburg Wiss. Anst. XXXI, beiheft 2, pp. 353–366, 8 text-figs.

MACDONALD, J. D. 1859. On the Anatomical Characters of a Remarkable Form of Compound Tunicata. Trans. Linn. Soc. London, XXII, 4, pp. 373–375, 1 pl.

METCALF, M. M. 1918. The Salpidae : a Taxonomic Study. Bull. U.S. Nat. Mus. 100, 2, pp. 1–193, 13 pls., 146 text-figs.

MICHAELSEN, W. 1904. Revision der compositen Styeliden oder Polyzoinen. Jahrb. Hamburg Wiss. Anst. XXI, beiheft 2, pp. 1–124, 2 pls., 1 text-fig., 1 map.

—— 1911. Die Tethyiden (Styeliden) des Naturhistorischen Museum zu Hamburg. Jahrb. Hamburg Wiss. Anst. XXVIII, beiheft 2, pp. 109–186, 25 text-figs.

—— 1914. Über einige westafrikanische Ascidien. Zool. Anz. Leipzig, XLIII, pp. 423–432.

—— 1915. Tunicata. Beitr. Meeresfauna Westafrikas. I, lief. 3, pp. 321–518, 4 pls., 4 text-figs.

—— 1919. Zur Kenntnis der Didemniden. Abh. Naturw. Hamburg, XXI, hft. 1, pp. 1–44, 3 text-figs.

—— 1920. Die Krikobranchen Ascidien des westlichen Indischen Ozeans : Didemniden. Jahrb. Hamburg Wiss. Anst. XXXVII, beiheft, pp. 1–74, 2 pls., 6 text-figs.

—— 1921*a*. Ascidien vom westlichen Indischen Ozean aus dem Reichsmuseum zu Stockholm. Ark. Zool. Stockholm, XIII, no. 23, pp. 1–25, 1 pl.

—— 1921*b*. Ascidiae Krikobranchiae des Roten Meeres : Clavelinidae und Synoicidae. Denkschr. Akad. Wiss. Wien, Math.-nat. Kl. XCVII, Ber. Komm. Ozean. Forsch. pp. 1–38, 1 pl., 1 text-fig.

Michaelsen, W. 1923. Neue und altbekannte Ascidien aus dem Reichsmuseum zu Stockholm. Mitt. Zool. Mus. Hamburg, XL, pp. 1–60, 12 text-figs.
—— 1924. Ascidiae Krikobranchiae von Neuseeland, den Chatham- und den Auckland-Inseln. Vidensk. Medd. naturh. Foren. Kjøb. LXXVII, pp. 263–434, 30 text-figs.
—— 1927. Einige neue Westaustralische Ptychobranchiate Ascidien. Zool. Anz. Leipzig, LXXI, pp. 193–203.
—— 1930. Ascidiae Krikobranchiae. Michaelsen, W., and Hartmeyer, R. Die Fauna Südwest Australiens, V, lief. 7, pp. 463–558, 12 text-figs.
Neumann, G. 1906. Doliolum. Wiss. Ergebn. Deutsch. Tiefsee-Exped. XII, lief. 2, pp. 95–243, 15 pls., 20 text-figs.
Nott, J. T. 1892. On the Composite Ascidians of the North Shore Reef. Trans. Proc. N.Z. Inst. XXIV, pp. 305–334, 7 pls.
Pallas, P. S. 1774. Spicilegia Zoologica, I, fasc. 10, pp. 41, 3 pls.
Pizon, A. 1908. Ascidies d'Amboine. Rev. Suisse Zool. Genève, XVI, pp. 195–240, 6 pls.
Quoy, J. R. C., and Gaimard, J. P. 1834. Voyage de l'Astrolabe, Zool. III, pp. 559–626, Atlas, 1833, pls. lxxxvi–xcii.
Ritter, W. E., and Byxbee, E. S. 1905. The Pelagic Tunicata. Mem. Harv. Mus. Comp. Zoöl. XXVI, pp. 195–214, 2 pls.
Savigny, J. C. 1816. Mémoires sur les Animaux sans Vertèbres, part II, fasc. 1, pp. 83–239, pls. i–xxiv.
Sewell, R. B. S. 1926. The Salps of Indian Seas. Rec. Ind. Mus. Calcutta, XXVIII, pp. 65–126, 43 text-figs.
Sluiter, C.-Ph. 1886. Über einige einfachen Ascidien von der Insel Billiton. Natuurk. Tijdschr. Ned.-Ind. XLV, pp. 160–232, 9 pls.
—— 1887. Einfache Ascidien aus der Bai von Batavia. Natuurk. Tijdschr. Ned.-Ind. XLVI, pp. 242–266, 3 pls.
—— 1891. Die Evertebraten aus der Sammlung des Königlichen naturwissenschaftlichen Vereins in Niederländisch Indien in Batavia. Ascidiae Simplices. Natuurk. Tijdschr. Ned.-Ind. L, pp. 329–348, 2 pls.
—— 1895. Tunicaten. Semon, R. W., Zool. Forschungsreisen in Australien, etc. V, lief. 2, pp. 163–186, 5 pls.
—— 1904. Die Tunicaten der Siboga-Expedition. I, Die Socialen und Holosomen Ascidien. Weber, M. C. W., Rep. Siboga Exp. LVI*a*, pp. 125, 15 pls.
—— 1905. Tuniciers recueillis en 1904, par M. Ch. Gravier, dans le Golfe de Tadjourah. Mém. Soc. zool. Fr. XVIII, pp. 1–21, 2 pls.
—— 1909. Die Tunicaten der Siboga-Expedition. II, Die Merosomen Ascidien. Weber, M. C. W., Rep. Siboga Exp. LVI*b*, pp. 112, 8 pls.
—— 1919. Über einige alte und neue Ascidien aus dem Zoologischen Museum von Amsterdam. Bijdr. Dierkunde, Leiden, XXI, pp. 1–12, 1 pl.
—— 1927. Les Ascidies de la Cote atlantique du Maroc. Bull. Soc. Sci. nat. Maroc, VII, pp. 50–99, 2 pls., 11 text-figs.
Sollas, I. B. J. 1903. On *Hypurgon skeati*, a new Genus and Species of Compound Ascidians. Quart. J. Micr. Sci. XLVI, pp. 729–735, 2 pls.
Stimpson, W. 1856. Descriptions of Some New Marine Invertebrata. Proc. Acad. Nat. Sci. Philad. VII, pp. 385–395.
Traustedt, M. P. A. 1893. Die Thaliacea der Plankton-Expedition. Henson, V. A. C., Ergebn. Plankton-Exp. II, E.a.A., pp. 16, 1 pl.
Van Name, W. G. 1918. Ascidians from the Philippines and Adjacent Waters. Bull. U.S. Nat. Mus. 100, I, pp. 49–174, 11 pls., 115 text-figs.
—— 1921. Ascidians of the West Indian Region and South-Eastern United States. Bull. Amer. Mus. Nat. Hist. N.Y. XLIV, pp. 283–494, 159 text-figs.
—— 1924. Ascidians from Curaçao. Bijdr. Dierkunde, Leiden, XXIII, pp. 23–32, 7 text-figs.
Verrill, A. E. 1871. Descriptions of New and Imperfectly Known Ascidians from New England. Amer. J. Sci. New Haven, ser. 3, I, pp. 443–446, 1 text-fig.
Vogt, C. 1854. Sur les Tuniciers nageants de la Mer de Nice. Mém. Inst. nat. genev. II, pp. 3–102, 6 pls.

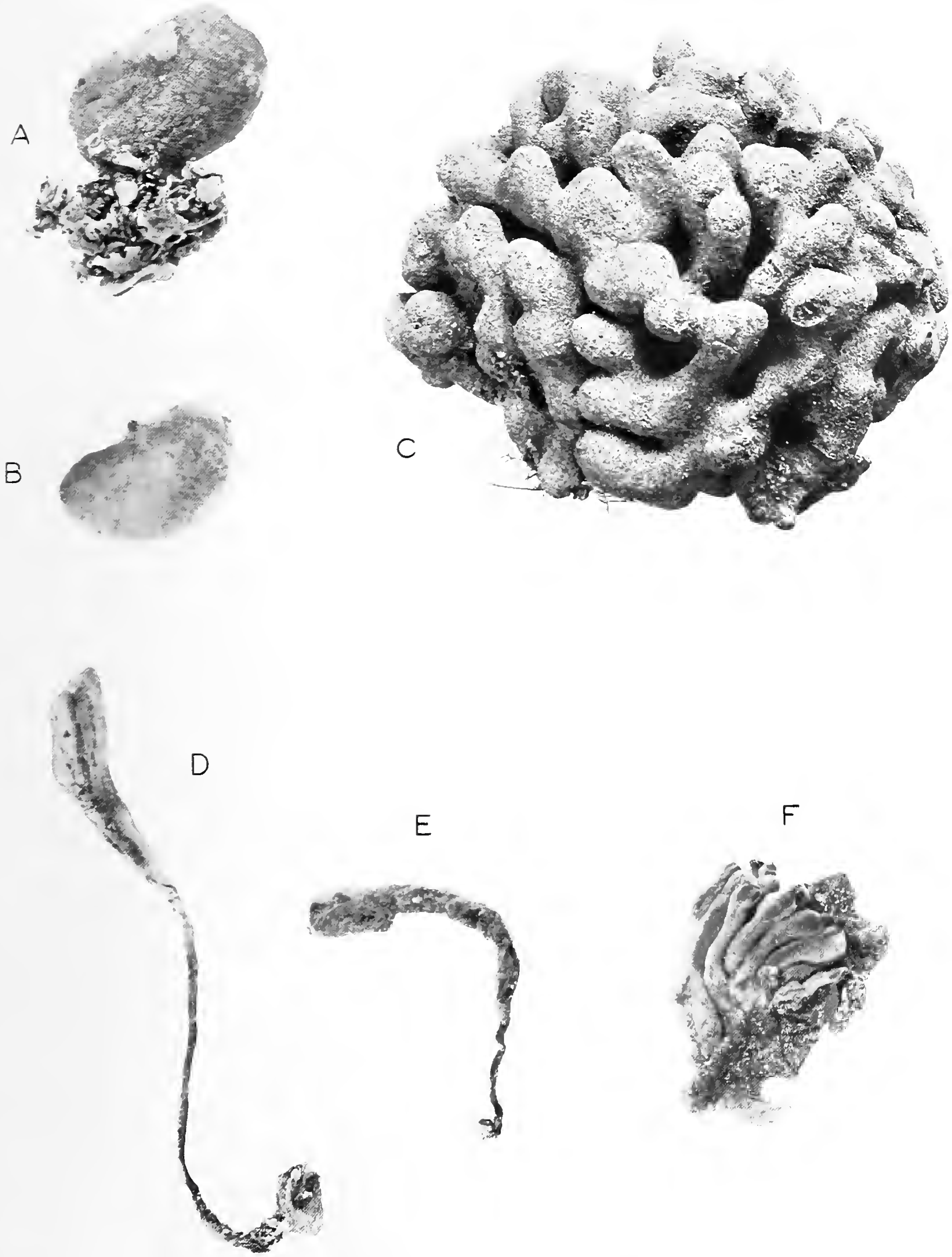
DESCRIPTION OF PLATE I.

A and B, *Polycarpa ovata* Pizon. Natural size. B, After removal of test.

C, *Eudistoma ovatum* (Herdman) from Cape Boileau, N.W. Australia. $\times \frac{1}{2}$.

D and E, *Podoclavella meridionalis* Herdman. Natural size. D, From the Barrier Reef. E, From Cape Boileau.

F, *Podoclavella molluccensis* Sluiter from Cape Boileau. Natural size.

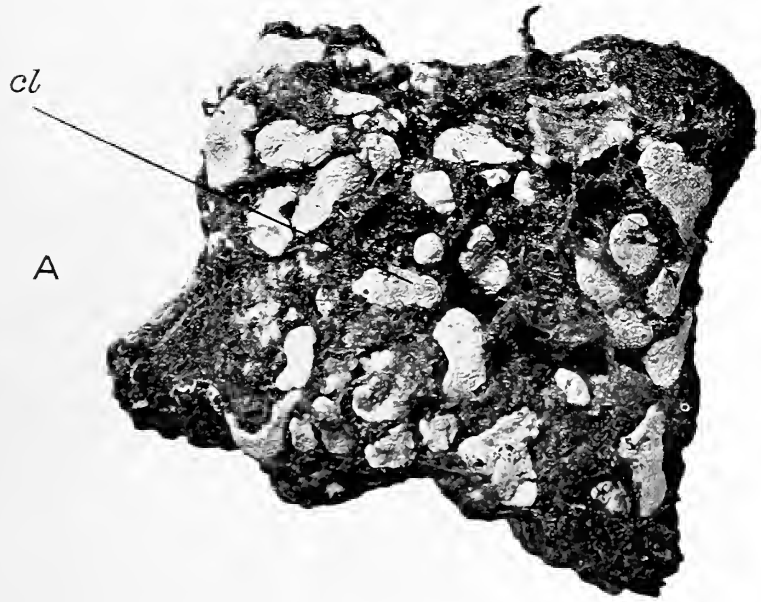


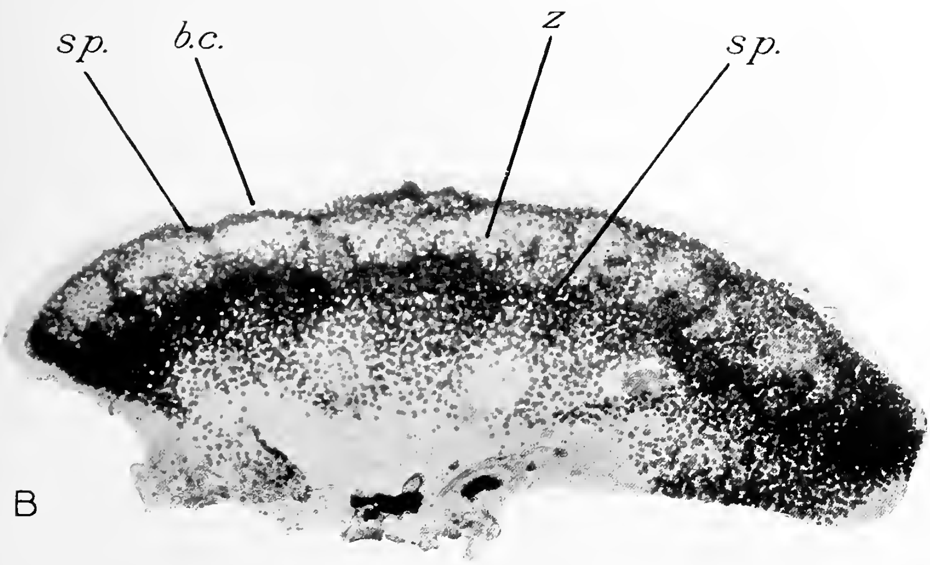
Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE II.

A, *Didemnum candidum* Sav., pink form, from Thalamita Flat, Low Isles. Natural size. Several cloacal apertures are visible.

B, *Trididemnum cyclops* Michaelsen. × 24. Vertical section. *b.c.* Bladder-cell layer. *cl.a.* Cloacal aperture. *z.* algal cells. *sp.* Spicules.



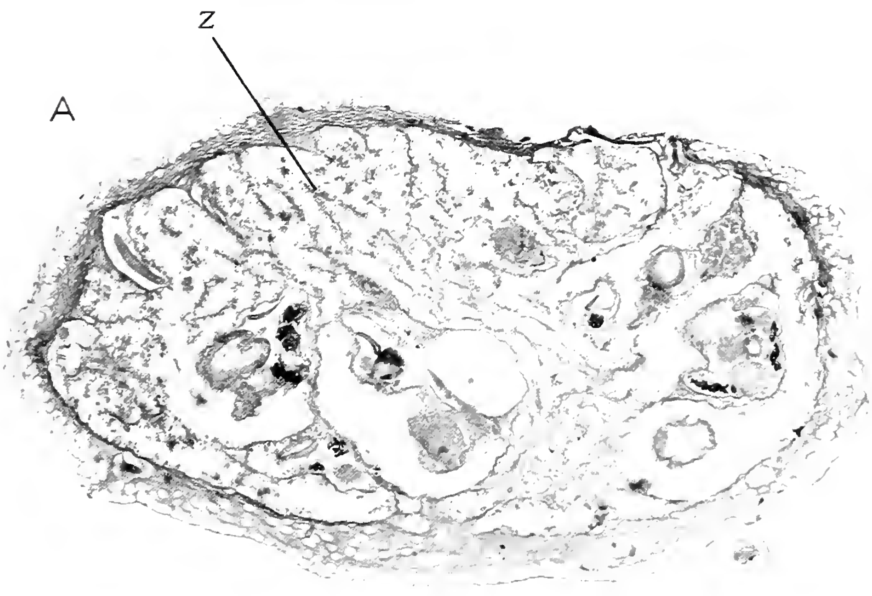


Adlard & Son, Ltd., Impr.

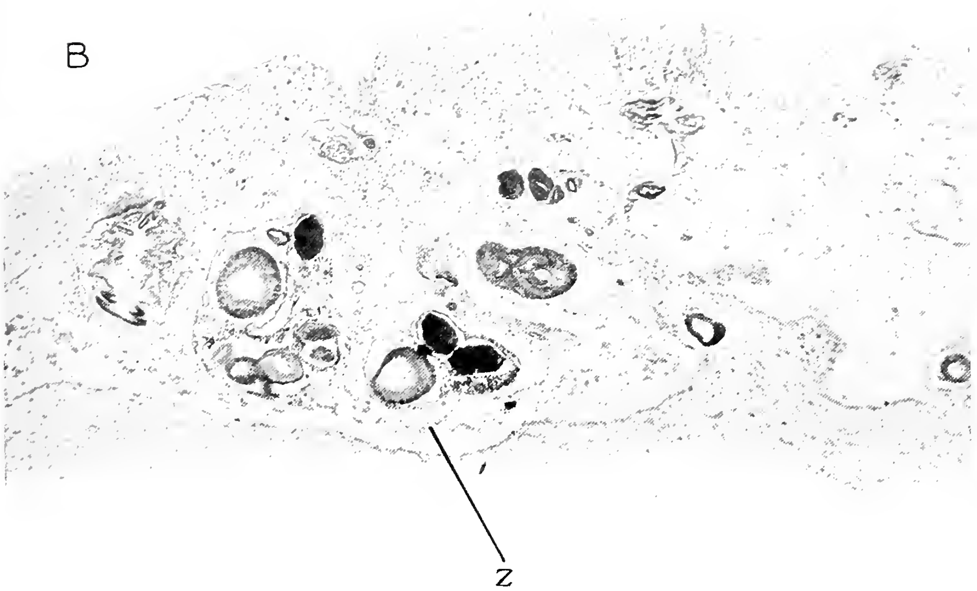
DESCRIPTION OF PLATE III.

A and B, Sections of *Diplosoma virens* (Hartmeyer). $\times$ 56. A, Type-specimen from Ceylon. B, Colony from Mangrove Park, Low Isles. *z*. Algal cells.

A



B



Adlard & Son, Ltd., Impr.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 4

AMPHIPODA

BY

K. H. BARNARD, D.Sc., F.L.S.
South African Museum, Cape Town

WITH FOUR TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W. 1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W. 7
1931

Price: Two Shillings and Sixpence.

[*Issued 26th September, 1931*]

Made and printed in Great Britain

AMPHIPODA

BY

K. H. BARNARD, D.Sc., F.L.S.,
South African Museum, Cape Town.

WITH FOUR TEXT-FIGURES

CONTENTS

INTRODUCTION.

THE collection of Amphipods obtained by the naturalists of the Great Barrier Reef Expedition is not a large one. That is mainly due to the Expedition being designed, not so much for collecting purposes, as for ecological and experimental work.

Small as it is, however, the collection is an interesting one. It contains species not hitherto recorded from the Australian coasts, one species which has not been collected since its description in 1880, and three species which it seems advisable to regard as undescribed. By far the greater part of the collection consists of planktonic Hyperiids.

The collection serves to show what a vast field awaits anyone with the opportunity of carrying out intensive investigation, with special methods, of the Amphipodan fauna of the Australian coasts.

My thanks are due to Dr. W. T. Calman, F.R.S., of the British Museum, for the opportunity of studying this collection ; and to Dr. T. A. Stephenson, who was a member of the Expedition, for information relative to the various species.

As regards the Gammarids there is little to be said. Fourteen species were collected, and of these four, including the three new species, all came from one station (St. 29). Ten species were found at Low Isles, including one widely-distributed pelagic form. The material of some species was too scanty for specific determination, belonging to the difficult genera *Maera*, *Hyale*, and *Ampithoe*.

The re-discovery of *Xenocheira* in Australian waters is interesting, though here again unfortunately only a single specimen is available.

With regard to the apparent poverty of Gammarids, Dr. Stephenson has supplied me with the following note: "The small number of Gammarids collected from the intertidal region at Low Isles is due partly to the fact that many of them live among coral shingle and can only be caught by the expenditure of much time; but it is probably also the reflection of a genuine (relative) poverty in the intertidal Gammarid fauna. On an English shore the Gammarids form a very noticeable element, whereas at Low Isles it was often difficult to find any, except in certain places where they were abundant.

"The collection of planktonic Amphipods from the station 3 miles east of Low Isles, on the other hand, may probably be regarded as a series very fairly representative of the Amphipod fauna of that area, since these collections were made systematically once a week throughout a period of twelve months, and contain a considerable number of specimens."

The most abundant Hyperiid is undoubtedly *Hyperia sibaginis*, Stebb., which occurred, usually in quantity, at 41 stations. It would be more accurate to say it occurred on 41 occasions, as 34 of the occasions were at the weekly station. About 750 specimens were obtained (see also *infra*, p. 127).

The next most abundant species were as follows:

Tullbergella cuspidata	87	specimens at	23	stations	(3 localities).
Lycaea bajensis	60	,,	9	,,	(1 locality).
Tetrathyrus forcipatus	34	,,	9	,,	(3 localities).
Simorhynchotus antennarius	21	,,	11	,,	(3 ,,).
Glossocephalus milne-edwardsi	15	,,	10	,,	(4 ,,).

The other species were obtained mostly as solitary specimens at a few, or at single, stations.

All the species are well known, or moderately well known, tropical and sub-tropical species of wide distribution. *Lycaea bajensis* and *Eupronoe laticarpa* are the only two which have not been widely recorded, unless the former is synonymous with *L. pulex* (see Pirlot, 1930, p. 25).

LIST OF STATIONS AT WHICH AMPHIPODA WERE COLLECTED, WITH THE SPECIES OBTAINED AT EACH STATION.*

Low Isles. M7. Shore collection. 20.iii.29.
Ampithoe, sp.

Low Isles. Shore collection. Tripneustes Spit. 21.iii.29.
Hyale, sp.

Low Isles. F9. Shore collection. 4.iv.29.
Hyale, sp.

Low Isles. F8. Shore collection. 10.iv.29.
Maera, sp.
Ceradocus rubromaculatus (Stimpson.).

* Station numbers in Roman numerals refer to dredgings. Those in Arabic numerals refer to the list of plankton stations in Vol. II, No. 2 (Russell and Colman, "The Zooplankton: I. Gear, Methods and Station Lists"). Shore collection numbers refer to the Key Chart of Low Isles in Vol. III, No. 2 (Stephenson and Others, "The Structure and Ecology of Low Isles and other Reefs," p. 23).

Low Isles. F5. Shore collection. 24.iv.29.
Ceradocus rubromaculatus (Stimpson.).

Low Isles. Lagoon. 20.vii.28.
Tullbergella cuspidata, Bov.

Low Isles. Anchorage. 1.x.28. Small medium tow-net, night haul.
Perioculodes aequimanus (Kossm.).

Low Isles. Anchorage. 20.xi.28. Coarse tow-net, day haul.
Synopia ultramarina, Dana.

Low Isles. Anchorage. 29.xi.28. Coarse tow-net, surface, night haul.
Synopia ultramarina, Dana.

Low Isles. Over reef flat. 16.v.29. Small medium tow-net, day.
Pontharpinia rostrata (Dana).
Xenocheira fasciata, Hasw.

Low Isles. Shore collection. (E. A. Fraser.)
Hyale sp.

Station XVI. 9.iii.29. ½ mile W. of N. Direction Is., 20 fathoms, stony.
Leucothoe spinicarpa (Abildg.). From Tunicates.

Station XIX. 10.iii.29. ½ mile N. of Eagle Is., 10 fathoms, shell gravel.
Leucothoe spinicarpa (Abildg.). } From Tunicates and Sponges.
,, *furina* (Sav.). }

Station XXII. 11.iii.29. To E. of Snake Reef. 13½ fathoms, mud.
Leucothoe furina (Sav.). From Tunicates.

Station 1. 27.vii.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 2. 30.vii.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Vibilia viatrix, Bov.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 3. 4.viii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 4. 7.viii.28. 1 mile N. of Low Isles. C. net, horizontal, surface.
Simorhynchotus antennarius (Claus).
Parascelus edwardsii, Claus.

Station 5. 11.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 6. 17.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 7. 22.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 8. 24.viii.28. 16° 30′ S., 145° 52′ E. Trinity Opening. 45 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Parascelus edwardsii, Claus.

Station 9. 31.viii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 10. 4.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 11. 6.ix.28. 16° 24′ S., 145° 52′ E. Trinity Opening. 61 metres. S. and C. nets, oblique.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 11. 6.ix.28. 16° 24′ S., 145° 52′ E. Trinity Opening. 61 metres. Nansen net vertical.
Eupronoe maculata, Claus.

Station 12. 11.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 13. 20.ix.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 15. 2.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Eupronoe laticarpa, Steph.
Sympronoe parva (Claus).

Station 16. 3.x.28. 3 miles E. of Low Isles. 32 metres. C.-Cl. net, horizontal.
Hyperia sibaginis, Stebb.
Eupronoe maculata, Claus.
Tullbergella cuspidata, Bov.

Station 17. 8.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Tullbergella cuspidata, Bov.

Station 18. 15.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 19. 20.x.28. 16° 20′ S., 146° 3′ E. Outside Trinity Opening. S. net, vertical, 180 m.w.o., bottom 225 metres.
Scina tullbergi (Bov.).
Hyperia sibaginis, Stebb.
Leptocotis tenuirostris (Claus).

Station 20. 20.x.28. 16° 19′ S., 146° 7′ E. Outside Trinity Opening. Nansen net, vertical, 250 m.w.o., bottom 600 plus metres.

Primno macropa, Guer.
Lycaeopsis themistoides, Claus.

Station 21. 22.x.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique, night haul.

Synopia ultramarina, Dana.
Sympronoe parva (Claus).
Lycaea bajensis, Shoem.
Simorhynchotus antennarius (Claus).

Station 22. 23.x.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.

Eupronoe maculata (Claus).

Station 23. 2.xi.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.

Eupronoe maculata (Claus).
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 24. 6.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.

Vibilia armata, Bov.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 26. 19.xi.28. 16° 24′ S., 145° 53½ E. Trinity Opening. 57 metres. S. net, oblique.

Hyperia sibaginis, Stebb.

Station 27. 21.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.

Hyperia sibaginis, Stebb.

Station 28. 23.xi.28. 16° 19′ S., 146° 5′ E. Outside Trinity Opening. S. net, vertical, 600 m.w.o., bottom 600 plus metres.

Vibilia armata, Bov.
Paraphronima crassipes, Claus.
Oxycephalus clausi, Bov.

Station 29. 24.xi.29. 16° 17′ S., 146° 2′ E. Outside Trinity Opening. B.S. net, 205 metres.

Ampelisca acinaces, Stebb.
Pardalisca australiensis, n. sp.
Oediceroides apicalis, n. sp.
Rhachotropis platycera, n. sp.
Tetrathyrus forcipatus, Claus.

Station 30. 28.xi.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.

Simorhynchotus antennarius (Claus).

Station 30A. 29.xi.28. 3 miles E. of Low Isles. 32 metres. C. net, oblique.

Simorhynchotus antennarius (Claus).

Station 31. 2.xii.28. 3 miles E. of Low Isles. 32 metres. B.S. net.

Hyperia sibaginis, Stebb.

Station 32. 5.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Rhabdosoma armatum (M. Edw.).
,, *whitei*, Bate.
Tetrathyrus forcipatus, Claus.

Station 33. 14.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.

Station 34. 19.xii.28. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 35. 27.xii.28. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Oxycephalus clausi, Bov.
Rhabdosoma whitei, Bate.

Station 36. 4.i.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Glossocephalus milne-edwardsi, Bov.
Rhabdosoma whitei, Bate.

Station 37. 14.i.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 39. 30.i.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Brachyscelus globiceps (Claus).

Station 40. 6.ii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Vibilia viatrix, Bov.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 41. 13.ii.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 42. 18.ii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simorhynchotus antennarius (Claus).

Station 43. 26.ii.29. 15° 16′ S., 145° 26½′ E. Off Cape Bedford. 30 metres. S. net, oblique.
Glossocephalus milne-edwardsi, Bov.

Station 44. 27.ii.29. 14° 44′ S., 145° 27½′ E. Off Lizard Is. 31 metres. S. net, oblique.
Hyperia sibaginis, Stebb.

Station 45. 28.ii.29. 14° 31′ S., 145° 35′ E. Outside Cook's Passage. S. net, vertical, 500 m.w.o., bottom 600 plus metres.
Scina lepisma, Chun.
Hyperia sibaginis, Stebb.
Primno macropa, Guer.
Brachyscelus globiceps (Claus).
Tetrathyrus forcipatus, Claus.

Station 46. 28.ii.29. 14° 32′ S., 145° 32′ E. Inside Cook's Passage. 33 metres. S. net, oblique.
Simorhynchotus antennarius (Claus).
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.

Station 47. 4.iii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simoryhnchotus antennarius (Claus).
Glossocephalus milne-edwardsi, Bov.

Station 48. 15.iii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Glossocephalus milne-edwardsi, Bov.

Station 49. 17.iii.29. 15° 47′ S., 145° 47′ E. Inside Papuan Pass. 46 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaeopsis zamboangae (Stebb.).
Brachyscelus globiceps (Claus).
Simorhynchotus antennarius (Claus).

Station 50. 18.iii.29. Outside Papuan Pass. S. net, 400 m.w.o., bottom 400 metres.
Hyperia sibaginis, Stebb.
Eupronoe maculata (Claus).
Brachyscelus globiceps (Claus).

Station 51. 25.iii.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Tullbergella cuspidata, Bov.

Station 52. 6.iv.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Simorhynchotus antennarius (Claus).
Tetrathyrus forcipatus, Claus.

Station 53. 13.iv.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 54. 20.iv.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 55. 26.iv.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 56. 7.v.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.
Glossocephalus milne-edwardsi, Bov.
Tetrathyrus forcipatus, Claus.

Station 57. 18.v.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 58. 25.v.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Simorhynchotus antennarius (Claus).

Station 59. 31.v.29. 3 miles E. of Low Isles. 32 metres. S. net, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.
Tetrathyrus forcipatus, Claus.

Station 60. 7.vi.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Lycaea bajensis, Shoem.
Tullbergella cuspidata, Bov.

Station 61. 14.vi.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Tullbergella cuspidata, Bov.

Station 63. 24.vi.29. 3 miles E. of Low Isles. 32 metres. C. net, oblique.
Hyperia sibaginis, Stebb.

Station 66. 11.vii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets, oblique.
Hyperia sibaginis, Stebb.
Simorhynchotus antennarius (Claus).
Glossocephalus milne-edwardsi, Bov.

Station 67. 17.vii.29. 3 miles E. of Low Isles. 32 metres. S. and C. nets. oblique.
Hyperia sibaginis, Stebb.
Tetrathyrus forcipatus, Claus.

SYSTEMATIC NOTES AND DESCRIPTIONS OF NEW SPECIES.

GAMMARIDEA.

Family Ampeliscidae.

Genus *Ampelisca*, Krøyer.

Ampelisca acinaces, Stebbing.

Stebbing, 1906, p. 108, figs. 25, 26.

Occurrence.—St. 29. 7 specimens 5–7·5 mm.

Remarks.—These specimens agree well with *acinaces*, except that the postero-inferior angle of pleon segment 3 is produced in a distinct acute point, with the margin above it sinuous, and that the 6th joint of peraeopod 5 is markedly ovate, being wider than the 3rd, 4th or 5th joints. Second joint of mandibular palp linear.

Distribution.—East Australia.

Family Phoxocephalidae.

Genus *Pontharpinia*, Stebbing.

Pontharpinia rostrata (Dana).

(Fig. 1.)

Stebbing, 1906, p. 146.

Occurrence.—Low Isles. Over reef flat. 12 ♂♂ 3 mm.

Remarks.—These specimens are attributed to Dana's species with a certain amount of reserve. They are not in conflict with Dana's figure as reproduced in Bate ('Cat. Amphip. Crust. B.M.,' 1862, p. 118, pl. xx, fig. 4); in fact Dana's delineation of the 4th joint of peraeopod 3 in particular fits the present specimens exactly. But the hands of gnathopods 1 and 2 are heavier (*cf.* Stebbing's description, 1906). Until the Australian fauna is better known these specimens may quite well be assigned to *rostrata*. Colour (as preserved) pale pink, the peraeon of a deeper shade than the pleon, eyes black.

Distribution.—Sooloo Sea and Port Jackson.

Family Leucothoidae.

Genus *Leucothoe*, Leach.

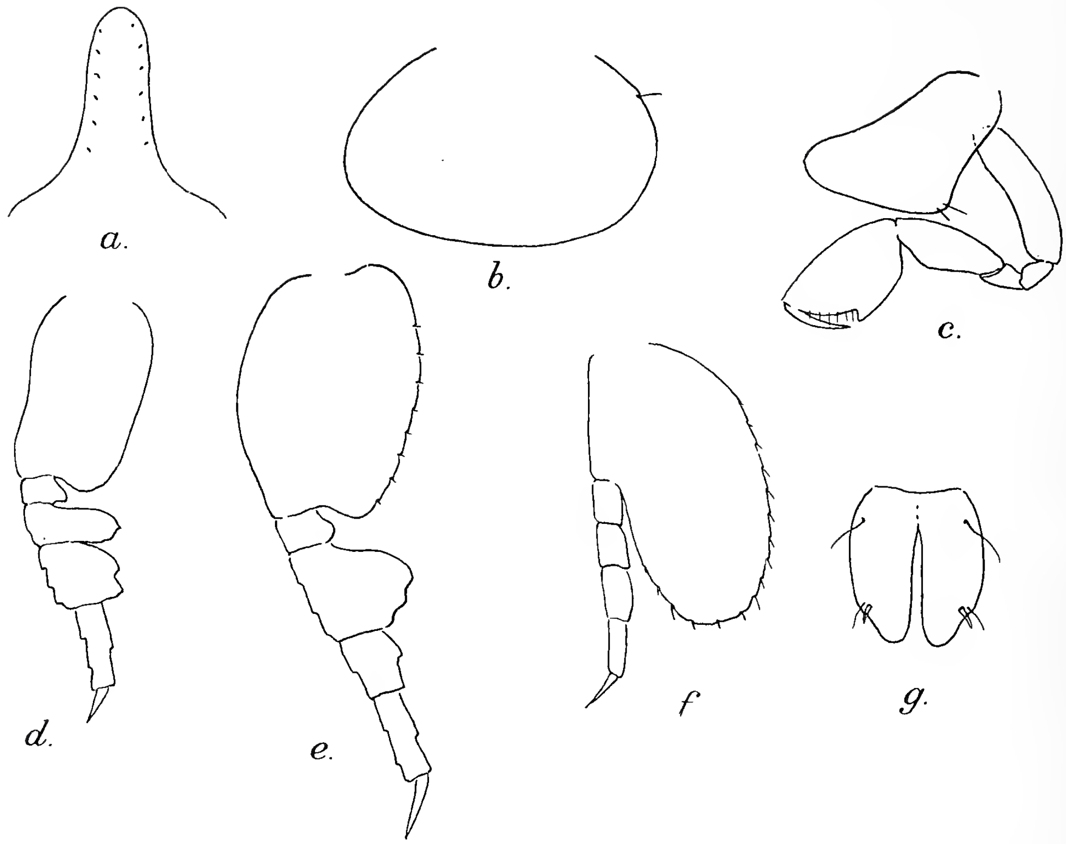
Leucothoe spinicarpa (Abildgaard).

Barnard, 1916, p. 148, and 1930, p. 338.

Occurrence.—St. XVI. From Tunicate, *Polycarpa pedata*, Herdman. 1 ♀, 10 mm.

St. XIX. From a sponge. 1 ♀, 6·5 mm., 1 ovig. ♀, 7 mm.

Distribution.—Cosmopolitan.



TEXT-FIG. 1.—*Pontharpinia rostrata* (Dana).—*a*. Dorsal view of rostrum. *b*. Pleon segment 3 *c*. Gnathopod 1. *d, e, f*. Peraeopods 3–5 (spines and setae omitted). *g*. Telson.

Leucothoe furina (Savigny).

Schellenberg, 1928, p. 635.

OCCURRENCE.—St. XIX. From atrial siphon of Tunicate, *Polycarpa aurita* (Sluiter). 2 ♂♂, 7 and 10 mm.

St. XIX. From branchial sac and peribranchial cavity of Tunicate, *Cnemidocarpa irma*, Hartm. 3 ♂♂, 7–8 mm., 1 ♀ with empty brood-sac, 9 mm.

St. XIX. From branchial sac of Tunicate, *Phallusia depressiuscula* (Heller). 1 ♀, 8 mm.

St. XXII. From branchial sac of Tunicate, *Cnemidocarpa irma*, Hartm. 1 ♂, 6 mm., 1 ovig. ♀, 7 mm.

REMARKS.—These specimens agree with Schellenberg's account as regards the shape of the postero-inferior angles of pleon segments 2 and 3. In the shape of the hand of gnathopod 2 there is no sexual difference.

DISTRIBUTION.—Gulf of Suez and Suez Canal, Red Sea, Ceylon, Laccadive Archipelago, Gambier Archipelago.

Family PARDALISCIDAE.

Genus *Pardalisca*, Krøyer.

Stebbing, 1906, p. 221.

Pardalisca australiensis, n. sp.

OCCURRENCE.—St. 29. 1 ♂, 7·5 mm.

DESCRIPTION.—Very close to *cuspidata*. No dorsal teeth on pleon segment 3, 2 on segment 4, 1 on segment 5. Fingers of gnathopods 1 and 2, and outer plate of maxilla 1 as in *cuspidata*; the latter appendage has 6 dentate spines and 1 seta, and the palp is widened distally, with a spinule in each notch along its distal margin.

REMARKS.—The "Challenger" obtained *P. marionis* at Marion Island, and the "Discovery" collected a new species in the Antarctic. This constitutes the third record of a species of this genus in the Southern Hemisphere.

The posterior half of the body of *marionis* was missing, so a comparison with that species is not possible. The 1st maxilla, however, is much more like Sars's figure of that of *cuspidata* (Sars, 1895, pl. cxli) than Stebbing's figure (1888, pl. xciv) of that of *marionis*.

Family OEDICEROTIDAE.

Genus *Perioculodes* G. O. Sars.

Perioculodes aequimanus (Kossmann).

Stebbing, 1906, p. 238.
Chilton, 1921, p. 527, fig. 2 (*longimanus*, non Bate & Westw.).
Schellenberg, 1928, p. 641, fig. 200.

OCCURRENCE.—Anchorage, Low Isles. 1 ♂, 1 ♀, 2·5 mm.

REMARKS.—With only two specimens it would not be advisable to regard the specific determination as absolutely certain, though the characters seem to bear out Schellenberg's remarks on the difference of this species from *longimanus* (Bate & Westwood). The antennae also are in harmony with Chilton's figure.

P. megapleon, Giles, *puliciformis*, Giles, and *serra*, Walker, 1904, are probably synonymous; Schellenberg does not refer to *serra*, Walker.

The genus has not hitherto been recorded from the Australasian region.

DISTRIBUTION.—Red Sea, Suez Canal, Chilka Lake, Talé Sap. Probably also Bay of Bengal and Ceylon.

Genus *Oediceroides*, Stebbing.

Oediceroides apicalis, n. sp.

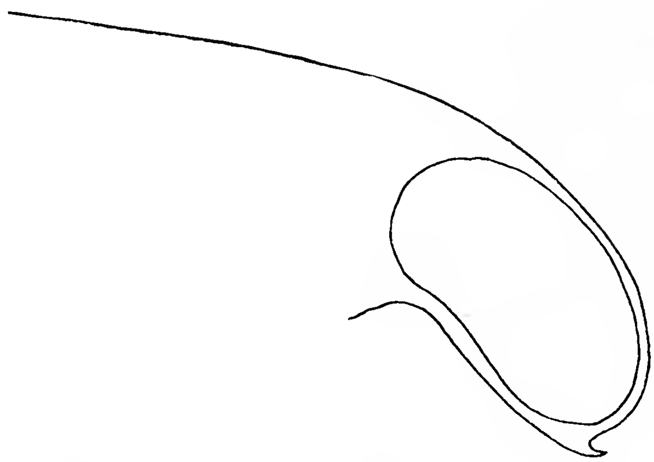
(Fig. 2.)

? Chilton, 1921*a*, p. 66 (*ornatus*, non Stebbing).

OCCURRENCE.—St. 29. 3 ♀♀, 6–9 mm.

DESCRIPTION.—I am inclined to think that these specimens are probably the same as Chilton's single specimen, but not the same as Stebbing's *ornatus* (1888, p. 855, pl. lxiv).

The body appears to be somewhat corrugated, especially in the largest specimen, but the preservation of the specimens is not quite perfect; there do not appear to be any tubercles, thus agreeing with Chilton's specimen. Chilton's description of the rostrum might apply to the present specimens, though he does not state that it is recurved or unciform. This feature, as well as the strongly curved profile of the whole rostrum, clearly separates these specimens from *ornatus*, and is very distinctive.



TEXT-FIG. 2.—*Oediceroides apicalis*, n. sp. Rostrum.

In other respects there are no marked diagnostic features, the gnathopods agreeing with those of *ornatus*. Eyes elongate-oval, contiguous along mid-dorsal line, maroon in colour.

Family SYNOPIIDAE.

Genus *Synopia*, Dana.

Synopia ultramarina, Dana.

Barnard, 1930, p. 367.

OCCURRENCE.—St. 21. 2 ♂♂, 2 ♀♀, 3·5–4 mm.

Anchorage, Low Isles, 1.x.28. 45 specimens 2–5 mm., including ♂♂, ovig. ♀♀ and juv.

Anchorage, Low Isles. 20.xi.28. 26 specimens 2–5 mm., ♂♂, ♀♀, juv.

Anchorage, Low Isles. 29.xi.28. 50 specimens 2–5 mm., ♂♂, ♀♀, juv.

DISTRIBUTION.—Indo-Pacific, tropical Atlantic.

Family EUSIRIDAE.

Genus *Rhachotropis*, S. I. Smith.

Rhachotropis platycera, n. sp.

(Fig. 3.)

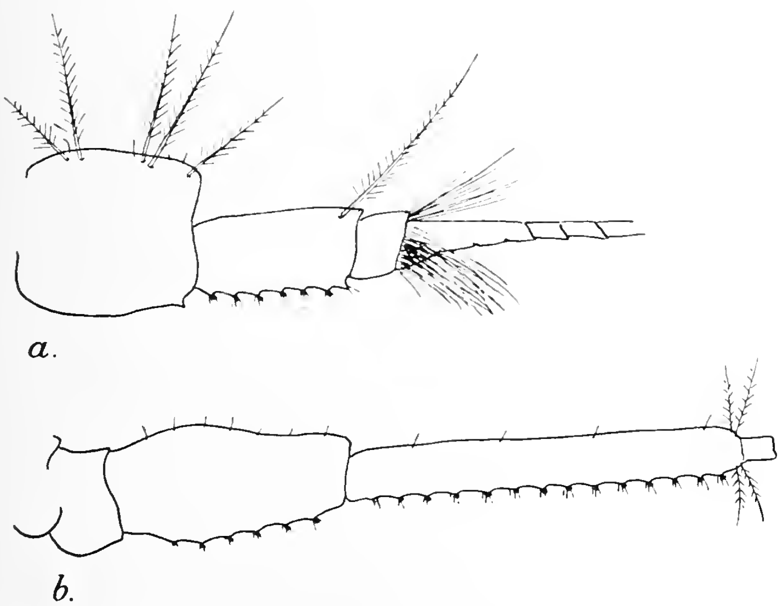
OCCURRENCE.—St. 29. 3 ♂♂, 1 ♀ (with fully developed brood-sac), 4–4·5 mm.

DESCRIPTION.—Close to *kergueleni*, Stebbing. Eyes well developed, horizontally

ovoid, very large, but well separated on top of head, similar in both sexes. Peraeon segment 7 with a medio-dorsal tooth on hind margin, not as large, however, as that on pleon segments 1 and 2. Pleon segments 1 and 2 tricarinate, the keels ending in teeth; segments 3 and 4 with only a medio-dorsal keel, ending in a tooth. Postero-inferior margin of pleon segment 3 serrate. Telson cleft almost to middle.

Peraeopods 3–5, 2nd joint nearly as in *kergueleni*, except that postero-inferior corner is acute only in peraeopod 5.

Antennae 1 and 2, peduncle in male noticeably flattened dorso-ventrally; antenna 1, 1st joint with 5–6 long plumose setae on outer margin, 2nd joint with 1 similar seta on outer apex, inner margin with bundles of short setae, each surrounding a calceolus, 3rd joint,



TEXT-FIG. 3.—*Rhachotropis platycera*, n. sp. *a, b.* Dorsal view of left antennae 1 and 2 of ♂.

very short, bearing on its apical margin, chiefly ventrally, a dense brush of setae, flagellum slender, calceoliferous. Antenna 2, 4th and 5th joints with setules on outer margin, bundles of setae with calceoli on inner margin, the latter with 2 pairs of plumose setae on apex, flagellum slender, calceoliferous. In ♀ antennae similar to those of ♂, but the peduncles are not flattened.

REMARKS.—Although close to *kergueleni* in the structure of the pleon and the basal joints of peraeopods 3–5, this species is at once distinguished by the presence of eyes. They are mart ked noonly by brown pigment, but by a distinct convexity, which, if it had been present in *kergueleni*, could scarcely have escaped Stebbing's notice. The antennae, although somewhat resembling Stebbing's figures (1888, pl. lxxxv), are distinct, especially if the "Challenger" specimens were males (Stebbing does not state the sex). The telson is very much more deeply cleft.

Family Gammaridae.

Genus *Ceradocus*, Costa.

Ceradocus rubromaculatus (Stimpson).

Stebbing, 1906, p. 430.
Schellenberg, 1925, p. 154, and 1928, p. 644

Occurrence.—Low Isles. F8. Shore collection. 10.iv.29. 1 ♂, 7 mm.

Low Isles. F5. Shore collection. 24.iv.29. 1 ♂, 8 mm.; 1 ovig. ♀, 7·5 mm.

Remarks.—Neither of the males shows any strong teeth on the palms of gnathopod 2.

Distribution.—Indo-Pacific, West, South and East Africa.

Genus *Maera*, Leach.

Maera, sp.

Occurrence.—Low Isles. F8. Shore collection. 10.iv.29. 1 ♀, 6 mm.

Remarks.—It is impossible to assign a single female specimen to any particular species amongst the several which are known from the Australasian region.

Family Talitridae.

Genus *Hyale*, Rathke.

Hyale, sp.

Occurrence.—Low Isles. Shore collection. (E. A. Fraser.) 1 ♂, 7 mm.

Low Isles. Shore collection. Tripneustes Spit. 21.iii.29. 3 ♂♂. 1 ovig. ♀, 5·5–7 mm.

Low Isles. F9. Shore collection. 4.iv.29. 3 mutilated specimens.

Remarks.—The material is too scanty for specific identification in this difficult genus. Several nominal species are reported from Australian waters.

Family Aoridae.

Genus *Xenocheira*, Haswell.

In 1906 Stebbing placed this genus in the *Photidae*, although Haswell had referred to its affinities with *Microdeutopus* (*Microdeuteropus*) (Haswell, 'Proc. Linn. Soc. N.S.W.,' vol. x, p. 106, 1885). In 1907 Chevreux ('Mem. Soc. Zool. France,' vol. xx, p. 510) described a second species, and on the basis of the mouth-parts transferred the genus to the *Aoridae* (see also Stebbing, 1910, p. 605).

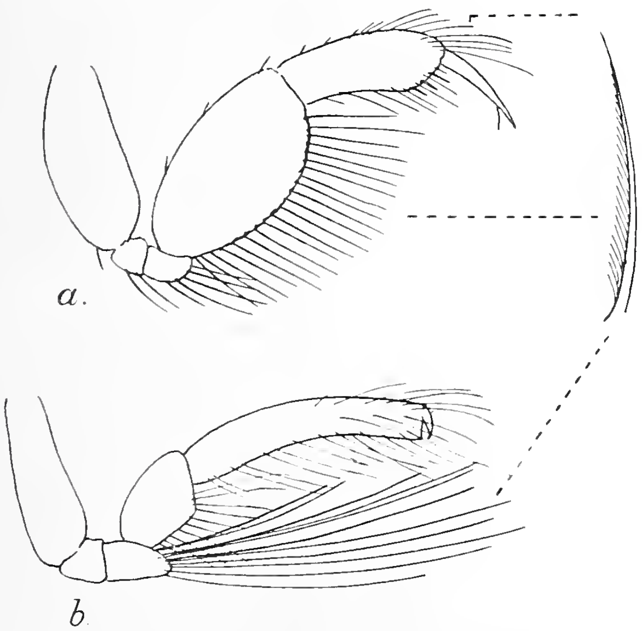
Xenocheira fasciata, Haswell.

(Fig. 4.)

Stebbing, 1906, p. 624.

Occurrence.—Low Isles. Over reef flat. 16.v.29. 1 ♀, 3 mm.

Remarks.—Chevreux (*l. c.*) has given good figures of *seurati*, from which it is clear that the present specimen cannot be identified with that species. There is every reason to assume that it is the same as Haswell's species, and though gnathopods 1 and 2 of the present specimen do not agree with his figures, it is impossible to place much reliance on the accuracy of such crude drawings.



Text-fig. 4.—*Xenocheira fasciata*, Hasw. *a*, *b*. Gnathopods 1 and 2.

From the figures here given it will be seen that in gnathopod 1 the 5th joint is very stout, both broader and longer than the 6th joint; the latter is scarcely subchelate. Gnathopod 2 is a perfectly normal appendage, the 5th joint not articulating with the 3rd as well as the 4th, but attached to the inner lower surface of the latter. This mode of attachment and the consequent inwardly bent position of the distal joints (more or less transverse across the body) is found in several allied genera (*cf.* Barnard, "Discovery" Report, in press). When such a limb is placed under a cover-slip the tendency is for the distal joints to become twisted. I believe that this is the explanation of the remarkable statement that the 5th articulates with the 3rd as well as the 4th joint.

In the present specimen the 5th joint of gnathopod 2 is not nearly so expanded as in Haswell's figures, or even Chevreux's figure of *seurati*.

When further material is available it will probably be found that not only is there sexual dimorphism in the 1st gnathopod of the adults, but considerable growth changes in the form of both gnathopods.

The species has not been collected in Australia since Haswell's time.

Distribution.—Port Jackson.

Family Ampithoidae.

Genus *Ampithoe*, Leach.

Ampithoe, sp.

Occurrence.—Low Isles. M7. Shore collection. 20.iii.29. 1 mutilated ♀, 7 mm.

Remarks.—Specific determination of a single female is impossible. The colour as preserved is dull purplish or vinous.

HYPERIIDEA.

Family Scinidae.

Genus *Scina*, Prestandrea.

Scina tullbergi (Bovallius).

Stephensen, 1918, p. 129 (*pacifica*).
Wagler, 1926, p. 384, figs. 34, 35.

Occurrence.—St. 19. 1 ♂, 3 mm.
Distribution.—Indo-Pacific, Atlantic.

Scina lepisma, Chun.

Wagler, 1926, p. 410, fig. 45, and 1927, p. 107, fig. 13.

Occurrence.—St. 45. 1 specimen in poor condition.
Distribution.—Indian Ocean ; tropical Atlantic.

Family Vibiliidae.

Genus *Vibilia*, Milne-Edwards.

Vibilia viatrix, Bovallius.

Barnard, 1930, p. 403.
Pirlot, 1930, p. 10.

Occurrence.—St. 2. 1 ♀, 7 mm.
St. 40. 2 ovig. ♀♀, 5·5 mm.
Remarks.—Colour after preservation in formalin, amber, with dark maroon stellate specks, eyes very dark.
Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Vibilia armata, Bovallius.

Barnard, 1930, p. 404.

Occurrence.—St. 24. 1 ♀, 4·5 mm.
St. 28. 1 ♂, 6·5 mm.
Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Family Paraphronimidae.

Genus *Paraphronima*, Claus.

Paraphronima crassipes, Claus.

Barnard, 1930, p. 409.

Occurrence.—St. 28. 1 ♀, 10 mm.
Distribution.—Pacific, Mediterranean, Atlantic.

Family Hyperiidae.

Genus *Hyperia*, Latreille.

Hyperia sibaginis, Stebbing.

Stebbing, 1888, p. 1379, pl. clxv (♂).
Pirlot, 1930, p. 18, fig. 6 (♀).
(*Non* Vosseler, 1901 = *Hyperioides longipes*.)

Occurrence.—St. 1. 30 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 2. 24 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 3. 32 ♂♂, adult and penult. instars, and ♀♀. 2–3·5 mm.
St. 5. 40 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 6. A lot of ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 7. 36 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 8. 5 adult ♂♂, 6 ♀♀, 2·5–3 mm.
St. 9. A lot of ♂♂, adult and penult. instars, and ♀♀, some ovig., 2–3·5 mm.
St. 10. 19 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 12. 38 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 13. 2 adult ♂♂, 3·5 mm. ; 7 ♀♀, 2–2·5 mm.
St. 15. 32 ♂♂ and ♀♀, 2–3·5 mm.
St. 16. Surface, 10 m., 25 m., 40 m. vert. distr. 4 ♂♂, 11 ♀♀, 2–3·5 mm.
St. 18. 44 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 19. 1 ♂, 2 ♀♀, 3–3·5 mm.
St. 26. 1 ♂, 1 ♀, 3 mm.
St. 27. 11 ♂♂, adult and penult. instars, 10 ♀♀, 3–3·5 mm.
St. 31. 5 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 33. 3 adult ♂♂, 3·5 mm.
St. 34. 4 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 35. 3 ♂♂, 3·5 mm.
St. 37. 8 ♂♂, adult and penult. instars, 3–3·5 mm.
St. 40. 4 ♂♂, 3-3·5 mm.
St. 42. 9 adult ♂♂, 3–3·5 mm., 3 ♀♀, 2–2·5 mm.
St. 44. 3 adult ♂♂, 3–3·5 mm.
St. 45. 2 ♀♀, 3·5 mm.
St. 47. 3 adult ♂♂, 3·5 mm.
St. 48. 8 adult ♂♂, 3·5 mm., 12 ♀♀, 2–2·5 mm.

St. 49 8 ♂♂, adult and penult. instars, and 8 ♀♀, 3–3·5 mm.
St. 50. 6 adult ♂♂, 3·5 mm.
St. 53. 36 ♂♂ and ♀♀, 2–3·5 mm.
St. 54. 13 ♂♂ adult and penult. instars, and 6 ♀♀, 2·5–3·5 mm.
St. 55. 30 ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 56. 3 ♂♂, 3·5 mm.
St. 58. 25 ♂♂ and ♀♀, 2–3·5 mm.
St. 59. 6 adult ♂♂, 21 ♀♀, 2–3 mm.
St. 60. A lot of ♂♂, adult and penult. instars, and ♀♀, 2–3·5 mm.
St. 61. 27 ♂♂ and ♀♀, 2–3·5 mm.
St. 63. 10 ♂♂ and ♀♀, 2–3 mm.
St. 66. 8 ♂♂, adult and penult. instars, and 4 ♀♀, 2–3·5 mm.
St. 67. 4 ♂♂, 15 ♀♀, 2·5–3·5 mm.

Remarks.—As remarked in the "Terra Nova" report (1930, p. 415), the notching of the outer margins of the outer rami of the uropods distinguishes this species from the other species of *Hyperia*.

The species apparently occurs at 0–40 metres; at St. 19, 45 and 50 closing nets were not used, and there is no evidence to show that the specimens were not caught near the surface. It seems to be generally abundant throughout the year; males, both adult and in the penultimate instar, and females were caught in all months. It is, however, curious that only one lot (St. 9) contains actually ovigerous females. The date of this haul was August.

Distribution.—Philippine Islands, China Sea, East Indies.

Family Phrosinidae.

Genus *Primno*, Guerin.

Primno macropa, Guerin.

Barnard, 1930, p. 424.

Occurrence.—St. 20. 1 ♂, penultimate instar, 3·5 mm., 3 ♀♀, 3–4 mm.
St. 45. 1 juv., 4 mm.

Distribution.—Indo-Pacific, Mediterranean, Atlantic, Antarctic.

Family Lycaeopsidae.

Genus *Lycaeopsis*, Claus.

Pirlot, 1930, p. 27 (key to species, p. 30).

Lycaeopsis themistoides, Claus.

Barnard, 1930, p. 425.
Pirlot, 1930, p. 27, fig. 8.

Occurrence.—St. 20. 3 ♀♀, 3–4·5 mm.

Distribution.—Indo-Pacific, Mediterranean, Atlantic.

Lycaeopsis zamboangae (Stebbing).

Barnard, 1930, p. 426.
Pirlot, 1930, p. 28, fig. 9.

OCCURRENCE.—St. 49. 1 ♂, 4 mm.
DISTRIBUTION.—Indo-Pacific, Atlantic.

Family PRONOIDAE.

Genus *Eupronoe*, Claus.

Eupronoe maculata, Claus.

Barnard, 1930, p. 426.
Pirlot, 1930, p. 33.

OCCURRENCE.—St. 11. 1 ♀, 5 mm.
St. 16. 1 juv., 2·5 mm.
St. 22. 1 ♀, 3 mm.
St. 23. 1 ♂, 5 mm.
St. 50. 1 ♂, 3·5 mm.
DISTRIBUTION.—Indo-Pacific, tropical and subtropical Atlantic, Mediterranean.

Eupronoe laticarpa, Stephensen.

Stephensen, 1925, p. 161, fig. 57.
Pirlot, 1930, p. 35.

OCCURRENCE.—St. 15. 1 ♀, 3 mm.
REMARKS.—Like Stephensen's and Pirlot's specimens, this specimen is also a female.
DISTRIBUTION.—East Indies, Morocco Coast (Atlantic).

Genus *Sympronoe*, Stebbing.

Sympronoe parva (Claus).

Stebbing, 1888, p. 1533, pl. cxcii.
Stephensen, 1925, p. 162, fig. 58.
Pirlot, 1930, p. 32.

OCCURRENCE.—St. 15. 1 ♂, 4·5 mm.
St. 21. 1 ♀, 5·5 mm.
DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Family LYCAEIDAE.

Genus *Lycaea*, Dana.

Lycaea bajensis, Shoemaker.

Barnard, 1930, p. 431, fig. 60.

OCCURRENCE.—St. 21. 1 ♂, 5 mm.
St. 23. 5 ♂♂, 5 mm., 11 ♀♀, some ovig., 3–4 mm.
St. 24. A lot of ♂♂ up to 5 mm., ♀♀, some ovig., up to 4 mm.
St. 33. 2 ♂♂, 5 mm.
St. 35. 1 ♂, 5 mm., 2 ovig. ♀♀, 3·5–4 mm.

St. 57. 1 ♂, 4 mm., 1 ovig. ♀, 3·5 mm.
St. 58. 1 ♂, 4 mm., 2 ♀♀, 3·5–4 mm.
St. 59. 1 ovig. ♀, 3·5 mm.
St. 60. 1 ♀, 3·5 mm.

REMARKS.—Agrees with the specimens assigned to this species in the "Terra Nova" Report. Pirlot (1930, p. 25) thinks that this is the same as *pulex*.

DISTRIBUTION.—Californian coast, New Zealand.

Family BRACHYSCELIDAE.

Genus *Brachyscelus*, Bate.

Brachyscelus globiceps (Claus).

Stebbing, 1888, p. 1555, pl. cxcvii, c (*latipes*).
Stephensen, 1925, p. 176, fig. 65.

OCCURRENCE.—St. 39. 1 ♂, 4·5 mm.
St. 45. 1 ♀, 5 mm.
St. 49. 1 ♀, 4·5 mm.
St. 50. 1 ovig. ♀, 6·5 mm.

DISTRIBUTION.—Zanzibar, Southern Pacific, Mediterranean.

Family OXYCEPHALIDAE.

Genus *Simorhynchotus*, Stebbing.

Simorhynchotus antennarius (Claus).

Barnard, 1930, p. 433.

OCCURRENCE.—St. 4. 1 ♂, 4 mm.
St. 21. 4 ♂♂, 6 mm.
St. 30. 1 ♂, 6 mm.
St. 30A. 1 ovig. ♀, 4·5 mm.
St. 42. 1 ♂, penult. instar, 4 mm.
St. 46. 2 ♂♂, 4·5 mm.
St. 47. 6 ♀♀ (1 ovig.), 3–3·5 mm.
St. 49. 2 ♂♂, 5–5·5 mm.
St. 52. 1 ♂, 4·5 mm.
St. 58. 1 ♂, 5 mm.
St. 66. 1 ♂, penult. instar, 4·5 mm.

REMARKS.—Ovigerous females were caught in March and November.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Genus *Oxycephalus*, Milne-Edwards.

Oxycephalus clausi, Bovallius.

Barnard, 1930, p. 433.

OCCURRENCE.—St. 28. 1 juv., 6·5 mm.
St. 35. 1 ♀, 14 mm.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Genus *Tullbergella*, Bovallius.

Tullbergella cuspidata, Bovallius.

Bovallius, 1890, p. 69, pl. ii, fig. 13, and text-figs. 1, 12, 18, 23, 27, 40, 51, 59, 61, 74.
Colosi, 1918, p. 212.
Spandl, 1927, p. 191, fig. 22.

OCCURRENCE.—St. 2. 1 ♀, 9 mm.
St. 3. 1 ♂, 6 mm., 4 juv., 3–5 mm.
St. 7. 3 ♀♀, 6–8 mm.
St. 10. 3 ♀♀, 5–6 mm.
St. 11. 4 ♀♀, 6–7 mm.
St. 12. 1 ♂, 2 ♀♀, 5–6 mm.
St. 13. 1 ♀, 6 mm.
St. 16. 1 ♂, 5 mm.
St. 17. 1 ♂, 6 mm., 1 ovig. ♀, 7 mm.
St. 23. 1 ovig. ♀, 6 mm.
St. 24. 8 ♂♂, 5–7 mm., 3 ♀♀, 4–5·5 mm.
St. 37. 2 ♀♀, 3·5–4 mm.
St. 40. 1 juv., 3·5 mm.
St. 41. 1 ♀, 5 mm.
St. 46. 1 ♀, 4·5 mm.
St. 51. 1 ♂, 9 mm., 1 ♀, 8 mm., 13 juv., 3–5 mm.
St. 55. 1 ♀, 5·5 mm.; 6 juv., 3–3·5 mm.
St. 56. 4 ♂♂, 7–10 mm.; 5 ♀♀ (3 ovig.), 9–10 mm.
St. 57. 1 ♂, 4 mm.
St. 59. 1 ♂, 9 mm.; 1 ovig. ♀, 10 mm.
St. 60. 1 juv. ♂, 3 mm.
St. 61. 1 juv. ♀, 3 mm.; 1 ovig. ♀, 8·5 mm.
Low Isles. From subumbrella surface of ? *Cotylorhiza* sp., 10 ♀♀, 6–9 mm.

REMARKS.—Ovigerous females were obtained in the months of May, June, October and November. Colour as preserved, pale horny, in many instances with maroon specks laterally, and along the hind margins of the segments, eyes maroon.

DISTRIBUTION.—Indian Ocean, Siam, Malay Archipelago.

Genus *Glossocephalus*, Bovallius.

Glossocephalus milne-edwardsi, Bovallius.

Walker, 1904, p. 237, pl. i, fig. 2 (*Elsia indica*, Giles).
Colosi, 1918, p. 221.
Stephensen, 1925, p. 202.
Spandl, 1927, p. 196, fig. 24.

OCCURRENCE.—St. 3. 3 ♂♂, 6–9 mm.
St. 11. 1 ovig. ♀, 6 mm.
St. 36. 1 ♂, penult. instar, 4·5 mm.
St. 37. 1 ♀, 4·5 mm.

St. 43. 1 ♂, 7 mm.
St. 46. 3 ♂♂, 8 mm.; 1 ♀, 6 mm.
St. 47. 1 ♂, 6 mm.
St. 48. 1 ♀, 6 mm.
St. 56. 1 ♀, 5 mm.
St. 66. 1 ♂, penult. instar, 4·5 mm.

REMARKS.—Stephensen regards *spiniger* Bov. as a synonym. The present specimens have the hind (lower) margins of the 6th joints of gnathopods 1 and 2 quite smooth.

DISTRIBUTION.—Indian Ocean, Mediterranean, tropical Atlantic.

Genus *Leptocotis*, Streets.

Leptocotis tenuirostris (Claus).

Barnard, 1930, p. 435.

OCCURRENCE.—St. 19. 1 ♂, 11 mm.

DISTRIBUTION.—Indo-Pacific, Atlantic.

Genus *Rhabdosoma*, Ad. & White.

Rhabdosoma armatum (Milne-Edwards).

Barnard, 1930, p. 436.

OCCURRENCE.—St. 32. 1 juv., 10 mm.

DISTRIBUTION.—Tropical Indo-Pacific and Atlantic.

Rhabdosoma whitei, Bate.

Barnard, 1930, p. 436.

OCCURRENCE.—St. 32. 1 ♂, 30 mm.
St. 35. 1 juv. ♂, 15 mm.
St. 36. 1 ovig. ♀, 25 mm. (mutilated).

REMARKS.—The ovigerous female lacks the uropods and telson, and consequently the identification may not be correct.

DISTRIBUTION.—Indo-Pacific, Atlantic.

Family THYROPIDAE.

(PARASCELIDAE, auctt.).

Genus *Parascelus*, Claus.

Parascelus edwardsii, Claus.

Stebbing, 1888, p. 1496, pl. clxxxv.
Stephensen, 1925, p. 211, fig. 83.
Pirlot, 1930, p. 35.

OCCURRENCE.—St. 4. 1 ♂, 6 mm.
St. 8. 1 ♀, 5 mm.

DISTRIBUTION.—Indo-Pacific, Mediterranean, Atlantic.

Family PLATYSCELIDAE.

Genus *Tetrathyrus*, Claus.

Tetrathyrus forcipatus, Claus.

Barnard, 1930, p. 439.
Pirlot, 1930, p. 42, fig. 11.

OCCURRENCE.—St. 29. 9 ♂♂, 1 ♀ with embryos, 5 mm. (*arafurae*).
St. 32. 8 specimens, 2–3 mm.
St. 40. 2 ovig. ♀♀, 3 mm.
St. 41. 1 specimen, 2 mm.
St. 45. 1 ♂, 5 mm. (*arafurae*).
St. 52. 7 specimens, 2–3 mm.
St. 56. 2 specimens, 3 mm.
St. 59. 2 specimens, 2·5 mm.
St. 67. 1 specimen, 2·5 mm.

REMARKS.—*T. moncoeuri* Stebb. and *arafurae* Stebb. are to be regarded as synonymous. Both typical *forcipatus* and *arafurae* occur in the present collection, the apex of the telson in the latter being markedly truncate, more so than in Pirlot's figure.

DISTRIBUTION.—Red Sea, California, East Indies, East Australia and New Zealand, Mediterranean and tropical Atlantic.

REFERENCES.

(Earlier references will be obtained from the works here cited.)

BARNARD, K. H. 1916. Contributions to the Crustacean Fauna of South Africa: No. 5. Amphipoda. Ann. S. Afr. Mus. XV, pp. 105–302, pls. xxvi–xxviii.

—— 1930. Amphipoda. Brit. Antarct. ("Terra Nova") Exp. 1910, Zool. VIII, pp. 307–454, text-figs. 1–63.

BOVALLIUS, C. 1890. The Oxycephalids. Nova Acta Soc. Sci. upsal. (3), XIV, pp. 1–141, text-figs. 1–87, 7 pls.

CHILTON, C. 1921. Fauna of the Chilka Lake: Amphipoda. Mem. Ind. Mus. V, pp. 519–558, text-figs. 1–12.

—— 1921*a*. Report on the Amphipoda obtained by the F.I.S. "Endeavour" in Australian Seas. Biol. Res. Fish. Exp. V, pp. 31–92, text-figs. 1–16.

COLOSI, G. 1918. Crostacei. III: Oxicefalidi. Racc. planct. "Liguria," II, fasc. 8, pp. 207–225, text-figs. 1–10, 1 pl. Publ. R. Ist. Firenze.

PIRLOT, J. M. 1930. Les Amphipodes de l'Expédition du Siboga. Pt. I. Hyperides. Siboga Exp. Monogr. XXXIIIa, pp. 1–55, text-figs. 1–11.

SCHELLENBERG, A. 1925. Amphipoda. Michaelsen, Beitr. Kennt. Meeresf. Westafr. III, pp. 113–204, text-figs. 1–27.

—— 1928. Amphipoda [Suez Canal]. Trans. Zool. Soc. London, XXII, pp. 633–692, text-figs. 198–209.

SPANDL, H. 1927. Die Hyperiiden der Deutschen Südpolar Expedition, 1901–1903. Deutsch. Südp. Exp. 1901–03, XIX (zool. xi), pp. 147–287, 1 pl. (map), text-figs. 1–63.

STEBBING, T. R. R. 1888. Report on the Amphipoda collected by H.M.S. "Challenger" during the years 1873–1876. Rep. Sci. Res. Voy. "Challenger," Zool. XXIX, pp. 1–1737, pls. i–ccxii, 1 map.

—— 1906. Amphipoda. I: Gammaridea. Das Tierreich, XXI, pp. 1–806, text-figs. 1–127.

—— 1910. Scientific Results of the Trawling Expedition of H.M.S.C. "Thetis." Mem. Austr. Mus. IV, pp. 565–658, pls. xlvii–lx.

STEPHENSON, K. 1918. Hyperiidea. Dan. Ocean. Exp. 1908–1910 to the Mediterranean, No. 5, II, D. 2, pp. 1–70, text-figs. 1–32.

—— 1925. Hyperiidea, part 3. Dan. Ocean. Exp. 1908–1910 to the Mediterranean, No. 9, II, D. 5, pp. 151–252, text-figs. 1–35.

WAGLER, E. 1926. Amphipoda: 2, Scinidae. Wiss. Erg. Deutsch. Tiefsee Exp. "Valdivia," XX, 6, pp. 317–446, text-figs. 1–59.

—— 1927. Die Sciniden der Deutschen südpolar Expedition, 1901–1903. Deutsch. Südp. Exp. XIX (zool. xi), pp. 85–111, text-figs. 1–14.

WALKER, A. O. 1904. On the Amphipoda. Ceylon Pearl Oyster Fisheries, Suppl. Report, XVII, pp. 229–300, 8 pls.

INDEX

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 5

THE ALCYONARIAN FAMILY XENIIDAE, WITH A REVISION OF THE GENERA AND SPECIES

BY

SYDNEY J. HICKSON, F.R.S.

Cambridge

WITH FIVE TEXT-FIGURES AND TWO PLATES

LONDON:

PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM

SOLD BY

B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4

AND AT

THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7

1931

Price Two Shillings and Sixpence

[*Issued 10th October, 1931*]

THE ALCYONARIAN FAMILY XENIIDAE, WITH A REVISION OF THE GENERA AND SPECIES

BY

SYDNEY J. HICKSON, F.R.S.,
Cambridge.

WITH FIVE TEXT-FIGURES AND TWO PLATES

CONTENTS

THE FAMILY XENIIDAE.

THE Xeniidae form a well-defined family with a combination of characters which distinguish them from all the other Alcyonaria.

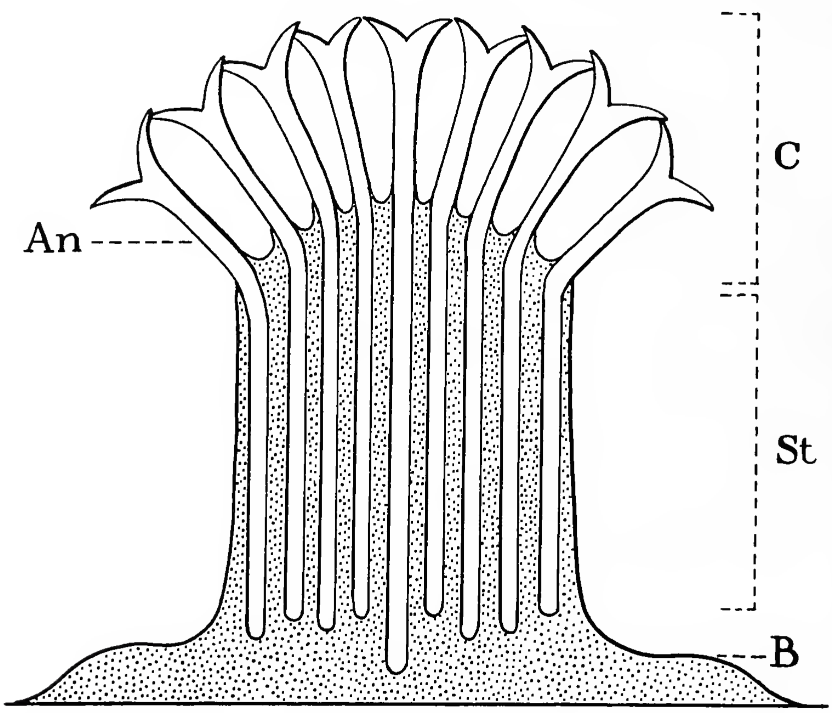
It is difficult to give a precise definition of the family, but the following statement, subject to the explanatory notes which follow, may be taken to indicate the characters by which its members may be identified.

The Xeniidae are soft fleshy Alcyonaria with comparatively slow powers of contractility. The polyps possess only one pair—the dorsal pair—of mesenteric filaments. The tentacles usually possess on each side two, three or more longitudinal rows of pinnules. Calcareous spicules, when present, are minute, round or oval corpuscles, rarely rod-shaped.

Explanation of Some Terms Used in this Paper.—If we examine a specimen of what we may call a typical *Xenia*, we find a base by which the colony is attached to a coral or some other support, which may extend into a thin membranous expansion over the support. From the base rises a smooth and usually cylindrical stalk, terminating above in a dense cluster of polyp heads which I have called the capitulum. In a vertical section it can be seen that the polyp cavities extend from the crown of tentacles through the stalk to the base, or to a considerable depth in the substance of the stalk as in *Alcyonium* and many other Alcyonaria.

Morphologically therefore the polyp consists of an upper free portion—the anthocodia —and a lower portion bound to its fellows by a common coenenchym.

In previous papers the word " polyp " is generally used for the anthocodia only and to avoid misunderstanding I have used it in this sense throughout, but it should be borne in mind that the polyp in this sense is only the free part of the morphological polyp. The stalk, being composed of a bundle of the lower portions of the polyps bound together by coenenchym, is a " syndete " in contrast to the mass of anthocodiae, which I have called the capitulum, and is in Prof. Bourne's (1900) terminology an " apodete."



TEXT-FIG. 1.—Diagram of a Xenia to illustrate the use of some technical terms. *B*, the base of attachment with membranous expansion; *St.*, the stalk or syndete; *C*, the capitulum or apodete; *An.*, the anthocodia of the polyp, usually called the polyp. The basal parts of the polyps are joined together to form the syndete.

Contractility.—Specimens of Xeniidae collected in the ordinary way and sent home in spirit have usually expanded polyps, in contrast with many other Alcyonaria in which the polyps are more or less contracted with their tentacles infolded when preserved.

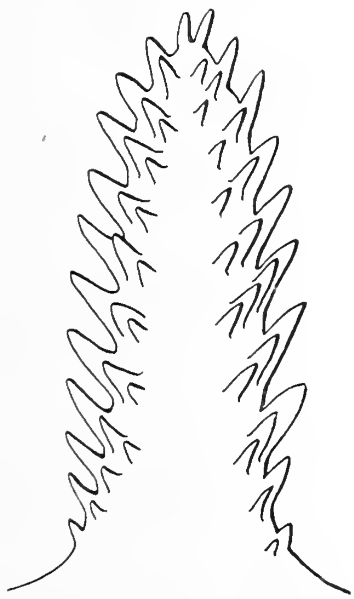
It is true that, with a few exceptions, the polyps are not retracted into the coenenchym nor into the shelter of verrucae, but there can be no doubt that they all possess considerable powers of contraction. The muscular system of the Xeniidae does not differ materially from that of other Alcyonaria, and we have the direct evidence of a few field notes to support the anatomical deduction. Dana (1848, p. 606), for example, wrote that in *Xenia florida* the polyps contract to one-half their full size when taken from the water.

We can form no true conception of the contractility of these Alcyonarians until a great many more accurate and detailed accounts of it are provided by those who have the opportunity to study the Xeniids alive upon the reefs.

The impression the study of preserved material has given me is that the polyps of the Xeniidae contract more slowly than they do in other Alcyonaria.

It is possible that some writers may have been misled by a statement by Saville-Kent (1893, p. 196) that " the component polyps (of *Xenia*) are entirely incapable of contraction." It is probably true that the polyps of many Xenias are entirely incapable of " retraction," but they are all capable of some degree of contraction.

The Mesenteric Filaments.—The absence of the ventral and lateral mesenteric filaments in a species of *Xenia* was first discovered by Ashworth (1898). Since then it has proved to be the most important distinguishing character of the family. I have examined a very large number of specimens of the four genera belonging to the family, and in every case these six filaments were absent. On the other hand they are present, so far as my



TEXT-FIG. 2.—A diagram of a tentacle of a Xenia to show the arrangement of the pinnules in oblique rows of 3–4 and three longitudinal rows on each side.

experience goes, in the full-grown polyps of species belonging to all the other families of the Alcyonaria.

The Tentacles.—The typical Alcyonarian tentacle is provided with a single row of pinnules on each side and is said to be " pinnate." In the majority of the Xeniids there are two, three or more rows of pinnules on each side of the tentacles.

It has been shown (Thorpe, 1928, p. 490) that in an early stage in the development of the tentacle there is a single row on each side as in other Alcyonaria but the additional rows are added as the tentacle grows to its full size.

In some cases when the tentacle is fully expanded the pinnules are arranged as represented in the diagram (Text-fig. 2). There are three or four pinnules in a row running obliquely across the tentacle on each side—the oblique rows—and each of these pinnules is a constituent member of a row running longitudinally from the tip of the tentacle to the base—a longitudinal row.

In such an expanded tentacle the pinnules may be all elongated cones in shape, and it is possible that in a healthy expanded living polyp they are always of that shape.

In preserved specimens the pinnules are usually much more unevenly distributed, and it is often very difficult to count the number in the oblique and longitudinal rows with accuracy. They have frequently the appearance of being quite irregularly scattered over the oral surface of the tentacles.

Moreover, in many of the preserved specimens either the whole of the pinnules or those of the inner longitudinal rows are contracted into the form of warts or low mounds. This matter, however, is discussed more fully in a subsequent section (p. 146).

Spicules.—I think there can be no doubt that some Xeniidae are entirely devoid of spicules ; but, when present, they are always in the form of minute round or oval discs, or more rarely thin rods. The spindles, needles, capstans and other forms of spicules which are so common in other groups of Alcyonaria are never found in this family. In the Pennatulid *Scytalium* small disc-shaped spicules 0·05 mm. in diameter are found, but in other families they are very rare.

Another point of great interest about these spicules is their remarkable uniformity in size. With a few exceptions these spicules range from 0·02–0·025 mm. in diameter.

In some species there may be spicules a little above or below these figures, but what is very striking is that when a large number of specimens from the tropical seas are examined, the variation in the size of the spicules is so small. A remarkable exception is found in *Cespitularia mantoni*, where the round disc-shaped spicules are 0·1 mm. in diameter, that is to say four times the diameter of the spicules of all the other specimens of Xeniidae from the Barrier Reef that I have examined (Text-fig. 5, p. 168).

Colour.—Many naturalists have described the delicate colour of the living Xenias, but at present it is not possible to make use of the colour characters in systematic work. Moreover, the chemical and physiological natures of these colours, which are soluble in spirit, are entirely unknown.

The most prevalent colour is pale blue, " a porcelain or electric blue " according to Saville Kent. Crossland, in a private letter, has told me that in Zanzibar he saw many blue Xenias. Several of the specimens described in this paper were labelled " blue." On the other hand many references to other colours will be found in the literature. Saville Kent, for example, gives coloured illustrations of Xenias that are " beryl green," pink, yellow and slate coloured, and Yonge describes a delicate dove-grey *Xenia* on Pixie Reef (1931, p. 140).

It seems very probable that, as with our own common sea-anemones, the colours of the species are very variable. The case of *Cespitularia coerulea* of Zanzibar lends strong support to this view. May (1900, p. 90) described the species as flesh-coloured with a tinge of bright blue. Crossland described the colours of three specimens of the same species, identified by Thomson and Henderson (1906, p. 415), as (1) " brilliant sea green," (2) " pink stems," (3) " pink body with blue-green zooids."

Gonads.—It would be of great interest if we possessed some knowledge of the time of spawning of the different species of the Xeniidae. If they all spawn at the same time some of the varieties may be hybrids ; if, on the other hand, there is an interval of one or more months between the sexual periods of the different species hybridization would be checked or prevented. On this point our knowledge is so scanty that it offers no solution for the problem.

The following notes on the presence of gonads in the dated specimens I have examined may be of some value for future investigators :

All the specimens with gonads were dioecious. There was no evidence of hermaphroditism at any stage. Unfortunately most of the specimens showed no gonads when examined with a lens, and it may be inferred therefore that they were not nearly ripe sexually. *Heteroxenia elisabethae* collected at the end of May had female gonads 0·75 mm. in diameter. *Cespitularia mantoni* collected in July had small male gonads 0·15 mm. in diameter, and a specimen of *Xenia plicata* collected in August to September had small female gonads 0·2 mm. in diameter.

All the other specimens were collected either in April or May and showed no gonads.

On Dimorphism in the Xeniidae.

The question of the dimorphism of *Heteroxenia* has been a subject of controversy for some years, and there can be no doubt that the correct interpretation of the facts in this case must have an important effect on the classification which should be adopted. Briefly stated the problem is as follows :

Is there a true anatomical and physiological dimorphism of the zooids in *Heteroxenia elisabethae* and some other species ; and if so, is the dimorphism of generic importance ?

Kölliker (1874) was the first to describe as dimorphic a specimen from Port Denison, in Queensland, which he named *Heteroxenia elisabethae.* He pointed out important differences in structure between the siphonozooids and the autozooids.

Haacke (1886), from an examination of specimens of the same species from Torres Straits, came to the conclusion that the siphonozooids are only young autozooid buds and that, therefore, there is no true dimorphism in the species.

May (1900) examined specimens from Zanzibar which he considered to belong to the same species and gave support to Haacke's opinion. May, however, studied the structure of the zooids more carefully, and pointed out a difference between the siphonozooids, which have incurled tentacles, and the young autozooids, which never have their tentacles incurled. As he did not discover any other difference between them he considered that they are not morphologically distinct. His contention that these zooids cannot be true siphonozooids because they bear rudimentary tentacles was not sound, as a tentacle occurs on some of the siphonozooids in the Pennatulacea (Marshall, 1883, and Kükenthal and Broch, 1911).

When May published his paper he had not seen, apparently, Ashworth's account of the same species from Zanzibar which appeared in the previous year.

Ashworth's examination of the zooids was much more thorough than May's. He found a constant difference in structure between the siphonozooids and young autozooids of 2 mm. or more in length, and that the young autozooids bear sexual cells and the siphonozooids do not.

Ashworth agreed therefore with Kölliker and Bourne (1895) that *Heteroxenia elisabethae* is truly dimorphic.

Kükenthal (1902) agreed with May that the genus *Heteroxenia* should be suppressed, and he classified *H. elisabethae* and some other dimorphic species with the species of *Xenia,* but accepted the view that dimorphism does occur in the Xeniidae in a form not very sharply defined. ("Einige Arten mit wenig ausgeprägten Dimorphismus der Polypen.")

Two years later (1904) Kükenthal published a paper in which he described under the name *X. fuscescens* a number of specimens collected by Dr. Hartmeyer principally near Tor, off the Sinai peninsula. He said that in this species there is great variability ; there

are examples without dimorphism, examples with pronounced dimorphism, and between them intermediate forms (p. 38). There are also some with spicules and some without spicules. The absence of spicules and the pale transparent colour seemed to be correlated with the absence of dimorphism, the dimorphic forms being darker in colour and provided with abundance of spicules. In 1911 Kükenthal's pupil Cylkowski wrote a dissertation on the dimorphism of the Alcyonaria, in which he described his investigation of thirteen specimens of this species from Jidda in the Red Sea. Four of these specimens were dimorphic, the others were not dimorphic. No mention is made of any intermediate forms beyond the statement that one small branch of a dimorphic form was not dimorphic (p. 12).

The presence of dimorphism is not a question of size; according to Cylkowski, there are both large and small specimens with siphonozooids, and there is no other difference between the dimorphic and monomorphic forms except in the greater extent of the superficial canal system in the former.

Cylkowski confirms Ashworth's statements concerning the relative sizes of the siphonozooids and the young autozooids at the margin of the colony, but says that elsewhere there are intermediate forms which may be siphonozooids in the process of being converted into autozooids, and comes to the conclusion (p. 16) that the siphonozooids are nothing else than developmental stages of the autozooids.

It is noteworthy that no one has yet been able to confirm Kükenthal's statement that there are intermediate forms between those that are dimorphic and those that are not. Thomson and Henderson (1906) and Light (1915), who examined large numbers of Xeniids, found no difficulty in separating the two forms, and I can confirm this from a study of the large collection of specimens I have examined. In my opinion a Xeniid is either dimorphic or it is not; there are variations in the relative numbers of autozooids and siphonozooids, and it is possible that a single small branch of a dimorphic colony may not show any siphonozooids, as in Cylkowski's specimen, although I have not seen one showing this feature, but there is no " beginning of dimorphism," and no intermediate forms between the two. The dimorphism is an established physiological condition in this genus.

The question of the dimorphism in *Heteroxenia elisabethae* seemed to have been definitely settled when Ashworth published his paper in 1899. He showed conclusively that the siphonozooids can be distinguished from the young autozooids of the same height by the size and condition of the tentacles and other characters. He gave the figures of a number of measurements of the two forms, and gave some excellent drawings to illustrate his descriptions (see his pl. 27, figs. 38 and 39).

No serious attempt was made to dispute Ashworth's observations and morphological conclusions until Cylkowski wrote his thesis in 1911. Unfortunately this very interesting paper is not easy to obtain; but thanks to the friendly offices of Prof. Pax I have been able to borrow a copy of the text, without the illustrations, from the library in Breslau.

In most respects Cylkowski confirms Ashworth's results, and indeed emphasizes the difference between the elaboration of the superficial canal system in the dimorphic forms as compared with the monomorphic forms, but states that except at the margin of the capitulum the siphonozooids and the young stages of the autozooids are indistinguishable.

As this is a point of considerable importance I have most carefully examined the

specimen from the Barrier Reef and cannot confirm Cylkowski's result in this respect. Young autozooids and siphonozooids of the same length are quite distinct throughout the whole capitulum. The former can be distinguished from the latter by their greater size, by the presence of pinnules on the tentacles and by the presence of gonads in the coelenteric cavities.

It must be remembered, however, that Cylkowski was working on material from the Red Sea, and it is possible that the difference in our results may be due to a difference in the species that were investigated.

In the controversy on the morphological distinction of the two kinds of zooids, very little attention has been paid to the possible physiological distinction between them.

In other dimorphic Alcyonaria the siphonozooids, having no tentacles and no digestive gland-cells either in the stomodaeum or in the mesenteric filaments, are not digestive zooids; on the other hand, their relatively large siphonoglyph and the retention (usually) of the dorsal mesenteric filaments suggest very forcibly that their main function is to maintain a flow of water throughout the coenenchym. The physiological distinction as regards nutrition is further emphasized in other Alcyonaria by the presence of the six digestive ventral and lateral mesenteric filaments in the autozooids and the absence of these filaments in the siphonozooids.

As Ashworth (1898) was the first to point out, the zooids of the Xeniidae possess no ventral and lateral mesenteric filaments, and in that respect a well-marked morphological distinction between autozooids and siphonozooids does not occur. As compensation for the absence of these mesenteric filaments, however, the stomodaeum of the zooids in this family is remarkably long and the epithelium bears numerous gland-cells, which are probably digestive in functions.

In order to throw some further light on the physiological function of the zooids of *H. elisabethae*, I have examined series of sections through the autozooids and siphonozooids of the very well-preserved specimens from the Barrier Reef.

In 1883 (p. 696), before the days of the modern technique for serial section-cutting, I made the statement that there is no siphonoglyph in the stomodaeum of the autozooids of this species. This was an error, which was corrected later by Ashworth (1899, p. 290). There is a siphonoglyph in the autozooids but it is not so pronounced as it is in the siphonozooids, and in the upper part of the stomodaeum fades away until its epithelium is hardly distinguishable from the epithelium of the rest of the stomodaeum. The mistake I made in my original statement may have been due to the examination of a few sections of the upper part of the stomodaeum in less well preserved material.

It may be noted here that according to Kükenthal (1906, p. 23) there is no siphonoglyph in the autozooids of *Heteroxenia uniserta.*

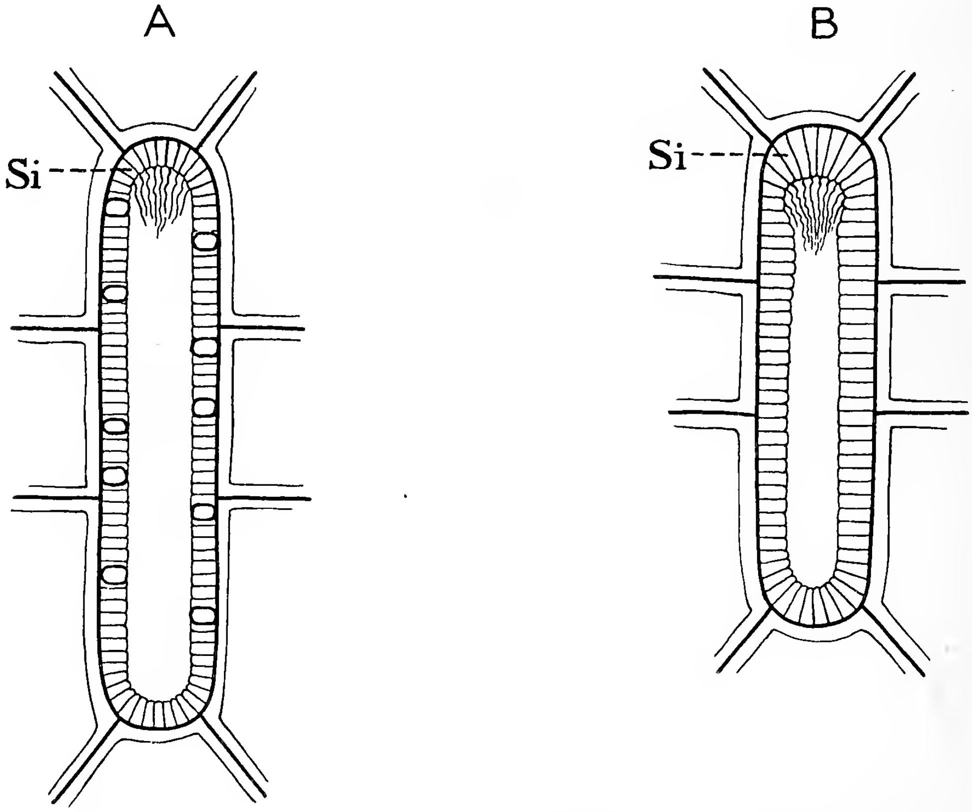
A careful study of series of sections through the whole stomodaeum of both autozooids and siphonozooids of a well-preserved specimen of *H. elisabethae* from the Barrier Reef has led to the following results:

The length of the stomodaeum of the autozooids, according to my measurements, is 3·5 mm. and of the siphonozooids 0·3 mm.

Ashworth (1899, p. 289), working on a specimen from Zanzibar, gave the length of the stomodaeum of the autozooids as 1·15 mm. and of the siphonozooids 0·6–0·8 mm. The discrepancy between the two sets of measurements may be partly accounted for by the fact that in my specimen the stomodaeum was straight and in Ashworth's it was

wrinkled and folded transversely. In both specimens, however, the stomodaeum of the autozooid is much longer than it is in the siphonozooid.

When seen in transverse section the stomodaeum of the siphonozooid appears as a flattened tube 0·2 mm. in greater, 0·055 mm. in lesser diameter (Text-fig. 3). It is lined internally by an epithelium 0·015 mm. in height, but this epithelium becomes thickened to 0·025 mm. in the ventral corner, *i. e.* at the siphonoglyph. The epithelium of the siphonoglyph is not only thicker, but the cells are more crowded together and the nuclei more numerous than they are elsewhere. The cells of the siphonoglyph bear long cilia



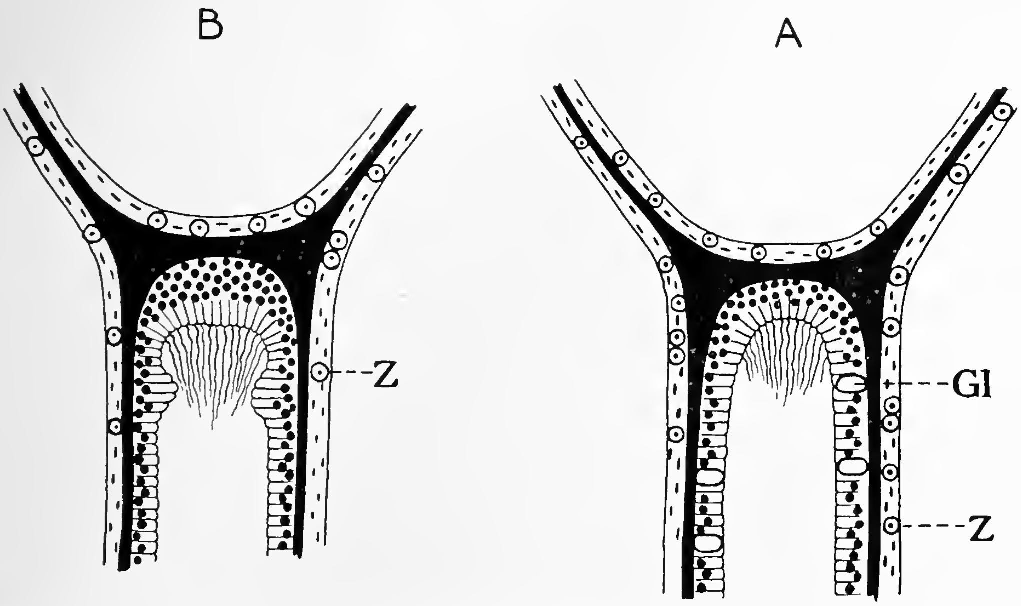
Text-fig. 3.—Transverse sections through the stomodaeum of A, an autozooid, and B, a siphonozooid of *Heteroxenia elisabethae* to show the relative proportions of the siphonoglyph (*Si.*) to the rest of the epithelium. A × 100 diams. B × 200 diams.

which are well preserved in the specimen (Text-fig. 4). The cells of the other parts of the epithelium may also be ciliated, but if present these cilia must be small and are not clearly preserved. The breadth of the siphonoglyph (as seen in transverse section) is approximately 0·03 mm.

In a transverse section of an autozooid the stomodaeum is seen to be more or less folded, but it may be flattened in places as in the stomodaeum of the siphonozooid. The greater diameter of the stomodaeum thus flattened is about 0·5 mm. The epithelium throughout is 0·015 mm. in thickness. In the region of the siphonoglyph the increase in thickness of the epithelium is inappreciable, and the cells do not appear to be much more crowded than elsewhere. But the siphonoglyph is distinguished by bearing a tuft of long cilia as in the siphonozooid.

Taking these figures as approximately accurate, I have reckoned that the proportion of siphonoglyph epithelium to general epithelium, as seen in transverse section, is in the autozooid 1 : 16 and in the siphonozooid 1 : 7. If these figures were to be multiplied by the lengths of the stomodaea of the zooids respectively so as to obtain the superficial areas of the siphonoglyphs and of the general epithelium the contrast would be very greatly increased. This cannot be done at present, as I have found it impossible to determine with any degree of accuracy the length of the siphonoglyph in the two zooids. It is indistinguishable in the upper part of the stomodaeum in the autozooid, and apparently extends throughout its whole length in the siphonozooid.

The structure of the stomodaea of the two forms seems, then, to prove almost conclusively that the siphonoglyph of the siphonozooid is relatively a much more important



TEXT-FIG. 4.—Transverse section through the ventral side of the stomodaeum of A, an autozooid, and B, a siphonozooid, of *Heteroxenia elisabethae* to show the further details of the structure of the siphonoglyph. *Gl.*, gland-cell in the autozooid; *z.*, zooxanthellae in the endoderm.

organ for maintaining a flow of water than it is in the autozooid. Moreover, as in other Xeniid polyps, the epithelium of the stomodaeum of the autozooid bears numerous gland-cells (Text-figs. 3 and 4); in that of the siphonozooid there are none. The siphonozooids, therefore, play no part in catching or digesting food, and their sole function, so far as we can judge, is to produce by the ciliary action of the siphonoglyph a constant flow of water into the canal system of the coenenchym, which the absence of gonads in the coelenteric cavities facilitates.

Haacke, in his account of *Heteroxenia elisabethae* from Torres Straits, said that the siphonozooids are not " professionelle Wasserpumpen." The evidence clearly proves that they are professional water-pumps.

Two other species, *H. capensis* and *H. uniserta,* are unquestionably dimorphic, and another, *H. rigida,* is probably dimorphic. (For the characters of these species see pp. 172, 173.)

The only question that remains, therefore, is whether we are justified in collecting the species of the Xeniidae which exhibit dimorphism into a separate genus. The character is one which can be determined at a glance ; there is never any difficulty in deciding whether a specimen is dimorphic or not. It would therefore be convenient to the systematist to keep them distinct, but apart from that consideration, the morphological investigation of the structure of these species shows that such a separation is scientifically sound.

This conclusion is confirmed by the facts of distribution. In all the localities in which *H. elisabethae* has been found, the Barrier Reef, the Philippines, Zanzibar and the Red Sea, monomorphic species occur living under similar conditions and environment. If dimorphism were due to any extraordinary or special conditions of life, the dimorphic form might be regarded as a variety of a similar monomorphic form specially adapted to survive under these conditions, but as they live side by side on the reefs and do not, so far as we know, give rise to intermediate or hybrid forms, the conclusion that they are quite distinct genetically seems to be inevitable.

The Species Problem in Xenia.—The difficulty of dividing the specimens of *Xenia* into definite specific groups is greatly increased, not diminished, as the numbers examined increase. The discontinuity which seems to occur when only a few odd specimens are studied dwindles and disappears until an almost complete continuity between many of the extreme forms is revealed.

Such an opinion would not have been expressed on the examination of the collection of Xeniids from the Barrier reef alone, rich as it is ; but only after a comparison of them with a large collection from many other localities. It has been my good fortune to be able to examine specimens from the Red Sea, Zanzibar, Diego Garcia, the Maldives, Ceylon, Celebes, Torres Straits, New Britain, Tonga, Fiji and Funafuti, and I have made preparations for the study of the tentacles, spicules and other characters of nearly all of them.

The conclusion I have arrived at is that the keys which have been proposed by Ashworth (1900), May (1900) and Kükenthal (1902), being based on characters which now appear to be very variable, are really of very little value, and that there is a need for a revision of the species of *Xenia*. The remarks that follow, however, have some application to the other genera of the family, and are therefore included in this section.

The principal characters used in the keys are the shape of the pinnules, and the number of them in the oblique and longitudinal rows. If it could be proved that the various shapes of pinnules that are seen in preserved specimens correspond with their shapes when the Xeniids are alive, and that no material change takes place when they are exposed to the sun in shallow water at low tide or when plunged into formalin or spirit, the shape of the pinnules might be of some systematic value. This assumption, however, does not appear to be sound.

The evidence that these Alcyonarians are to some extent contractile is conclusive, and in all probability the pinnules are among the first parts of the polyps to undergo some withdrawal. The number of pinnules in the rows is also assumed in these keys to be a constant character. A statement is often made in the description of a species that the number of pinnules in an oblique row is three or in another species four, as if this was a definite character for all the polyps of the colony. The careful study of a large number of tentacles of any specimen shows, however, that there is considerable variation in this

respect with the species having more than two in a row. Tentacles with 3, 4 or even 5 in an oblique row may be found in one colony (see *H. elisabethae*, p. 171).

I have not found any Xeniid with two pinnules in an oblique row on each side, such as *X. ternatana* is said to have, but I doubt whether they are less variable in that species. Several examples are quoted in the following pages in which the numbers of rows of pinnules are said by previous authors to be variable, and I have found some variation in this respect in nearly all the specimens I have examined.

The shape of the pinnules (pointed cones, blunt cones, warts, mounds, etc.) of preserved specimens is a character due in large measure to the degree of contraction in or before preservation, and is certainly very unreliable for making specific distinctions. Different parts of the same colony often differ very materially as regards the shape of the pinnules. A most striking example of this is described in a specimen of *X. crassa* (p. 160).

Several cases have been quoted of species with pinnules on both sides or all round the tentacles (*e. g. X. bauiana* and *X. medusoides* by May and *X. depressa* by Kükenthal). It is noteworthy that in all these cases the polyps belonged to old Museum specimens. I had not seen any example of it until my attention was called to a specimen collected by Dr. A. C. Haddon, to which a note was attached "dry on arrival." In this specimen several of the tentacles showed wart-like pinnules on both sides.

Unless there is some strong evidence to the contrary derived from the observation of living Xenias or from really well-preserved specimens, this character must be regarded as a result of post-mortem shrivelling.

Kükenthal (1914, p. 6), in the last paper he wrote on the Xeniidae, came to the conclusion that the characters based on the shape and numbers of the pinnules are unsatisfactory for systematic purposes, pointing out that the numbers of rows are often very difficult to count, and that the shape of the pinnules is often due to contraction. With these conclusions I am in full agreement.

If we abandon the use of the tentacles as affording reliable characters for the definition of species, there is nothing left that would help in the formation of a scientific key to the species.

The characters of the stalk are so variable, and seem to be so dependent on the surface of the support and the presence of immediate neighbours, that it has no value.

The spicules in a few cases (*e.g. Cespitularia mantoni*) give examples of discontinuity, but in the great majority of Xeniidae are so uniform in shape, size and variability that they afford no reliable help for distinguishing species.

As regards other anatomical features, such as the mesenteric filaments, stomodaeum canal system, etc., all that can be said at present is that series of sections through several colonies from different localities have revealed a uniformity of structure which gives no clue to any differentiation of species.

It seems probable that the deep-water forms *X. crosslandi*, *X. antarctica* and *X. wandeli* do represent discontinuous groups and are therefore true species.

As regards the forms which are found in shallow water in the Red Sea, Indian Ocean, Malay Archipelago and the Pacific Ocean, there seems to be a continuous series from the forms with large polyps 20–30 mm. in length (*X. elongata*) to those with very small polyps 1 mm. in length (*X. nana*).

It would be quite reasonable to regard them all as varieties of one widespread species adaptable to the very varied environments of warm, shallow sea-waters.

But to give them all one specific name would obviously be inconvenient, and possibly premature.

I have therefore adopted a system based partly on the size of the polyps and partly on geographical distribution—a system which is frankly artificial, but may be convenient as a temporary measure.

Three well-defined genera can be recognized—

1. *Xenia*, with monomorphic polyps. Margin of the capitulum well defined. Stalk, when present, simple or slightly branched, and free from anthocodiae.

2. *Cespitularia*, with monomorphic polyps. Margin of the capitula not well defined. Dendritic or lobate in growth. Stalk and branches with small scattered anthocodiae.

3. *Heteroxenia*, with dimorphic polyps.

4. *Sympodium*. As the species included in the genus *Sympodium* may be only young growth stages of species of *Xenia* there is some doubt as to its validity. The polyps in these forms do not form a syndete but arise independently from a membranous base. Some notes on *Sympodium* are given at the end of this paper (p. 174).

My thanks are due to Prof. Stanley Gardiner for giving me facilities to work in the Zoological Department in Cambridge, to Prof. Pax, of Breslau, for the loan of a copy of Cylkowski's dissertation, to Prof. Ashworth for the loan of an unpublished manuscript on the Dimorphism of *Heteroxenia*, and to several members of the Expedition for information concerning the living Xenias.

The Genus XENIA, *Lamarck*.

It is not necessary to give an account of the very complicated history of this genus. Those who are interested in the subject will find a list of references in the papers by Kükenthal (1902) and previous authors.

There can be no doubt that the Alcyonarian described in MS. by Savigny and published by Lamarck in 1816 was a *Xenia*, and that the type-species of the genus is *X. umbellata*. Since that time a very large number of species have been mentioned or described as species of this genus. Some of these, such as *X. caribaeorum* (D. & M.), are not related to the genus at all (see Kükenthal, 1902, p. 660), and others have been so inadequately described that they cannot be recognized. There remain about 30 species, excluding those which are now referred to *Heteroxenia*, which have been well or moderately well described.

In addition to these there are about a dozen species attributed to other genera, *e. g. Anthelia*, *Sympodium* and *Clavularia* which may be only young growth stages of certain Xenias.

Kükenthal's (1902) definition of the genus was as follows:

> "Mit sterilem einfachem oder getheiltem Stamm und scharf davon abgesetzter Endscheibe. Bei einigen Arten beginnender Dimorphismus der Polypen. Siphonozooide mit Tentakeln aber ohne Pinnulae."

This definition has to be modified as a consequence of more recent researches on the genus.

In the first place there are many specimens which undoubtedly belong to the genus which have no stalk, and in the second place the dimorphic species must now definitely be relegated to the distinct genus *Heteroxenia* (see p. 141).

A revised definition of the genus may read as follows :

Colonies monomorphic. Polyps (*i. e.* the anthocodiae of the polyps) not retractile. Stalk, when present, sharply differentiated from the capitulum, unbranched, or if branched the branches simple and of approximately the same length.

There is never any difficulty in determining whether any specimen of this family is or is not dimorphic. The only species about the dimorphism of which there has been any controversy is *Heteroxenia elisabethae* (see p. 141). In the literature of the subject there is no mention of dimorphism—nor of "the beginning of dimorphism"—in any of the species mentioned in the following lists, and a careful search for any signs of dimorphism in all the specimens of these species I have examined has proved that the colonies are simply monomorphic.

There are no species included in the genus in which the anthocodiae of the polyps are retracted into verrucae or below the general surface of the coenenchym. In this respect they differ from species attributed to the genus *Cespitularia*. But the anthocodiae are to some extent contractile, and in preserved specimens various degrees of contraction may be seen in the body-wall, the tentacles and in the pinnules. In many specimens which undoubtedly belong to the genus *Xenia* there is no stalk—that is to say, the colony is more or less planoconvex in section and the anthocodiae project from the whole of the convex surface.

It is possible, or even probable, that at a later stage of growth these specimens would have developed a stalk, but they must be included in the genus even if it is the case that they never develop this character.

The stalk, when present, is thick and either simple or in some cases divided into a few short branches, but the capitula at the ends of these branches are so close set that the colony appears to have only one capitulum. In *Cespitularia* the branches are discrete. (Plate II, fig. 6).

There can be little doubt that in some Xenias there are no spicules, but when they are present they are thin discs or ovals having a maximum diameter of 0·018–0·025 mm. In some cases rods and twins occur with the common types, but the shape of the spicules is so variable that they are rarely of any value for specific diagnosis. A point of some interest about them, however, is that they are very rarely over 0·025 mm. or less than 0·018 mm. in diameter. The largest I have seen are curiously enough in the very small specimens of *X. nana* (Hickson, 1931), where the twins are 0·05 mm. in length.

Geographical Distribution.—The genus has a wide distribution in shallow tropical seas, extending from the Red Sea through the Indian Ocean, Malay Archipelago and Australian Barrier Reef to the western half of the Pacific Ocean. Kükenthal's *X. antarctica* was found in 457 metres off Bouvet Island, and Jungersen's *Ceratocaulon wandeli*, which is probably a *Xenia*, was found in 538 metres in the Arctic Sea N. 66° 16′, W. 25° 20′.

No species of the genus have been found in the Atlantic Ocean nor in the Pacific Ocean east of longitude 180°, unless the *Sarcothela edmondsoni* (Verrill, 1928) of Hawaii proves to be a *Xenia*.

From the shallow waters off the coast of Zanzibar ten species have been described as distinct, from Ternate eight species, and from various localities in the Pacific Ocean nine species.

In many cases a new species has been named on the description of only one or two specimens from a locality and on characters which we know now are extremely variable, and there can be no doubt that if such characters are used in the same way for specific diagnosis, the number of species of the genus will be extended indefinitely.

The work of the past is not to be regretted because the description of a new species is almost invariably more detailed and better illustrated than the description of a specimen referred to an established species. We have at least learned a great deal by this process of the variations within the genus. But it is incredible that in the shallow waters of the coast of Zanzibar, for example, there are ten true Linnean species. Some may be only young growth stages, some varieties due to purely local conditions, and others may possibly be hybrids.

It may be premature to act upon the belief that specific differentiation does not exist in the genus, or that there is only one very variable species in the world, but some reduction in the number of recognized species must be made unless the systematics of the genus are to be thrown into absolute confusion.

It may be most convenient to deal with this matter geographically in the first instance.

Red Sea.—Three species have been described from the Red Sea: *X. umbellata*, *X. fuscescens* and *X. coerulea*. The monomorphic forms of *X. fuscescens* are so closely allied to *X. umbellata* that it is impossible to separate them (see p. 173), and as Thomson and MacQueen (1908, p. 51, footnote) remark, "it seems certain that *X. umbellata*, *X. fuscescens* and *X. coerulea* are very closely related. It may be necessary eventually to unite them in one variable species."

To these species May (1900, p. 81) added *X. blumi* (Suez) and Kükenthal (1913) *X. ternatana* (Jedda) and *X. hicksoni* (Massowa) as inhabitants of the Red Sea. Kükenthal's two specimens of *X. hicksoni* differ from the type in having much bigger polyps and smaller spicules. The description is not very full, and the specimens may be only a variety of *X. umbellata*.

Zanzibar.—The following species have been recorded:

X. umbellata.	*X. medusoides.*
X. tumbatuana.	*X. coerulea.*
X. quinqueserta.	*X. membranacea.*
X. sansibariana.	*X. ternatana.*
X. bauiana.	*X. crosslandi* (*rigida*).

In *X. bauiana*, according to May (1900, p. 77), there are three rows of pinnules on each side of the middle line on both sides of the tentacles. *Xenia quinqueserta* and *X. sansibariana* are evidently closely related, from May's original account, the only difference between them being that the pinnules are thick and blunt in the former and long and pointed in the latter. They are both said to possess five rows of pinnules, but in a specimen attributed to *X. quinqueserta* by Thomson and Henderson (1906) there are said to be three to five rows of pinnules, and these authors remark, "we suspect that both may be varieties of *X. umbellata*."

X. tumbatuana (May) seems to me a very doubtful species. It has three rows of thick blunt pinnules on the tentacles, but in other respects does not differ materially from the other two species.

No spicules were found in any of the three species mentioned above.

X. medusoides (May, 1900, p. 88) was described from two specimens in the Hamburg Museum. The only distinguishing feature of this species is that the pinnules are arranged all round the slender axis of the tentacles. I have frequently found this condition in shrivelled, badly-preserved specimens, and it is difficult to believe that it is anything but an artefact. This view is confirmed by the description (by Kükenthal, 1902, p. 656) of another specimen in the Stuttgart Museum in which the pinnules were strongly contracted. The only case in which I have observed rows of pinnules on the aboral side of tentacles that are apparently fully expanded is that of *X. garciae*.

X. membranacea was first described by Schenk (1897, p. 57) from Ternate, and specimens were afterwards attributed to the species by Ashworth (1900, p. 512) from New Britain and by May (1900 p. 86) from Zanzibar. The accounts of this species are by no means in agreement, and it is difficult to determine what are its distinguishing features. The name implies that there is a membranous expansion of the base, but this is only an adaption to the habit of growing on branches of corals. The pinnules of the tentacles are arranged in three or four rows according to Schenk, in four rows according to May, and in six rows according to Ashworth, but in all cases the lower end of the axis of the tentacles only is free from pinnules.

X. ternatana was originally described by Schenk (1897) from Ternate. A specimen from Zanzibar was referred to this species by Thomson and Henderson (1906, p. 412) on the ground that it has only two rows of pinnules. In many other respects it diverges from the type. The polyps are much larger than they are in the type and agree more closely with those of a typical *X. umbellata*, but if there are only two rows of pinnules they differ from this species to a very marked degree. It is often difficult to determine whether there are three or four or five rows of pinnules on the tentacles of the Xenias on account of contraction leading to overcrowding; but it should not be difficult to determine that there are two rows and not more than two rows. *X. ternatana* might stand, therefore, for the present as an independent species, but a more elaborate and detailed account of its tentacles is very desirable.

Xenia rigida (Th. and H., 1906, p. 413) must not be confounded with May's species of the same name. Kükenthal (1914, p. 8) has suggested that the name be changed to *Xenia crosslandi*. It was found in 10 fathoms of water. The species appears to be quite distinct as it has remarkably large (0·06 × 0·08 mm.) "rod-like" spicules. *X. coerulea* is almost certainly a young stage of *X. umbellata*.

Summary.—In the Zanzibar region there occurs one very variable species, *X. umbellata*, one doubtful species, *X. ternatana*, and in deeper water one species, *X. crosslandi*.

Indian Ocean.—There is a well-defined species *X. garciae* (Bourne, 1895, p. 475) which is found in Diego Garcia and other reefs, *e.g.* Egmont reef, Addu Atoll and Hulule Male Atoll (Hickson, 1903, p. 479) in the Indian Ocean.

The polyps in this species are small, the body-wall being from 1·5–3 mm. in height, and the pinnules of the outer row of the tentacle almost meet on its aboral surface. The spicules are spherical or oval but smaller than usual—0·01–0·02 mm.—and very irregular in outline in the type-specimen.

X. nana from Ceylon is an even smaller species (Hickson, 1931), with only a single row of pinnules on each side of the tentacles. Some of the spicules are larger than usual, and it therefore seems to be quite distinct from *X. garciae*. But this species may be only a juvenile form of a larger one. A small form of *X. umbellata* has also been described from

Diego Garcia by Bourne, and specimens of *X. ternatana* and *X. umbellata* from Ceylon by Thomson and Henderson (1905, p. 273).

Malay Archipelago.*—Schenk (1896) described eight new species of *Xenia* from Ternate. Two were described from the examination of two specimens each and six from one specimen each.

There are many respects in which these eight species resemble one another. The length of the polyp body is 4–7 mm. except in *X. rubens*, where the figures given by Schenk are 6–11 mm. They have all with the exception of *X. ternatana* three pinnules in an oblique row on the tentacles, and they all bear spicules of the usual type of approximately the same size, *i. e.* about 0·02 mm. in diameter. The differences between them are mainly differences in the size and characters of the pinnules of the tentacles and in the form of the stalk, when present.

As these characters are very variable, it seems probable that all these species from Ternate are really forms of only one species, and that this species may be difficult to distinguish from *X. florida* of Dana. It may be premature to lump all these species into one at present, but the number should, in my opinion, be considerably reduced.

Xenia ternatana stands by itself in having only two rows of pinnules, a character which should be clearly recognizable even in preserved specimens from the three to four rows of pinnules in the other species. It would, however, be of great interest if it could be definitely known that in the specimens attributed to this species there are never more than two pinnules in a row in any of the tentacles.

X. plicata seems to be distinguished from the others by a greater degree of contractility of the pinnules and the remarkably long slender tentacles.

X. crassa, X. fusca, X. membranacea, X. viridis seem to me all variants of one species which should be called *X. crassa.*

X. blumi is closely related to *X. plicata*, with which it was found associated, and so is *X. rubens*, although according to Schenk's statement it has much shorter tentacles and on that account may be distinct.

The species from Ternate may therefore be reduced to three—*X. ternatana, X. plicata* and *X. crassa*—with two doubtful species, *X. blumi* and *X. rubens.*

Kükenthal (1911) attributed specimens found in 3–4 metres in the Kei Archipelago to the species *X. florida* and *X. viridis.* He does not give a full account of them, but according to his key plan (1902) *X. florida* should have two rows of pinnules and *X. viridis* three.

Dana (1848) described a species, *X. elongata*, from Amboyna with exceptionally large polyps (20–30 mm. in height). There is a piece of a colony in my collection from Celebes which resembles *X. elongata* in the exceptional size of the polyps and other respects. No mention is made by Dana nor by Wright and Studer of spicules in this species. In my specimen they are absent.

I am inclined to think, therefore, that *X. elongata*, Dana, should stand, for the present, as a distinct species.

Xenia hicksoni is the name given by Ashworth (1899, p. 245) for a single specimen from Celebes. It may prove to be only a local variety of *X. umbellata*, which it resembles in the general form of the colony, but it differs from that species in the smaller size of the polyps and in some other respects.

Pacific Ocean.—The coast of New Britain seems to yield a rich harvest of Xenias.

* See Appendix, p. 177.

Ashworth (1900) described a new species, *X. novae-britanniae*, and referred other specimens to the species : *X. umbellata*, *X. membranacea*, *X. crassa* and *X. viridis*.

For reasons clearly stated by Ashworth (p. 521) *X. novae-britanniae* must stand as a distinct species. It was founded on the examination of eight specimens, all of which can be readily distinguished from the other species in the same region. The principal character is the relatively small size of the polyps.

The New Britain specimen of *X. umbellata* differs from the Red Sea type in some respects, but is correctly referred to that species. The other three should in my opinion be all referred to *Xenia crassa*.

A *Xenia* from New Ireland was described by Lesson under the name *Actinantha florida*. According to Kükenthal (1902, p. 647) this species is distinct from *X. danae* of the Fiji Islands, with which it was formerly confounded, in having only two rows of pinnules on each side of the tentacles. It is quite impossible to be certain of the characters of these two species described long ago by Lesson and Dana. Dana considered that his species from Fiji was identical with Lesson's species from New Ireland. Verrill (1869, p. 283), who had the advantage of examining all Dana's types, said he could see no difference between his specimen of *X. florida* and *X. umbellata*. Gray included Lesson's *Actinantha florida* in his genus *Loridella*, which has " fusiform spined spicules." Kükenthal (1902, p. 468) described a specimen from Port Denison under the name *X. florida* and states that it has only two rows of pinnules on each side of the tentacle, but gives no information as to the presence or absence of spicules.

It can lead to nothing but confusion if we try to retain these two species. We may take Verrill's opinion that *X. danae* is identical with *X. umbellata*, and relegate *X. florida* to the list of species that are imperfectly described.

Kükenthal (1914, p. 9) described a new species, *X. multispiculata*, from Fiji and Tonga. This species is clearly related to *X. crassa*, but differs from it in the greater size of the polyps (9–16 mm. in body length) and the larger number of pinnules in a longitudinal row (26–30). I have some specimens from Tonga collected by Mr. J. J. Lister which are more closely related to *X. crassa* as regards measurements, but in other respects resemble *X. multispiculata*.

I have also a most instructive series of ten specimens collected by Prof. J. Stanley Gardiner at Funafuti in the Ellice Group. There can be little doubt that they all belong to the same species, but, as they show various stages of contraction, they form a series which connects the more typical varieties of *X. crassa* with the description of *X. multispiculata*. In some specimens the pinnules are low warts, in others they are long and slender with a length of 0·75 mm., and in some cases both kinds of pinnules with intermediates are found in polyps of the same colony.

However, I have not found any tentacle with more than 16–18 pinnules in a longitudinal row, and the number in an oblique row is 3–4, not 2–3, as in *X. multispiculata*. There may be, therefore, a specific distinction between them.

In all the specimens from Tonga and Fiji I have examined the spicules are very numerous and crowded on the tentacles and pinnules, and most of them are discs with a diameter of about 0·02 mm. The spicules of *X. multispiculata* are said to be oval in shape with greatest diameter of 0·015 mm.

Australia (including Torres Straits).—The Xeniid fauna of the Great Barrier Reef was described by Saville-Kent (1893, pp. 196–198), but unfortunately the four species that

he named were never worked out in detail or clearly defined. He mentions a specimen of *X. elongata* with polyps half an inch (12·5 mm.) in diameter, and three other species which he could not identify—*X. pulsitans*, *X. ochracea* and *X. brunnea*. As his systematic work was so incomplete, some important and very interesting notes on the natural history of the species seem to have been generally overlooked by subsequent writers.

He laid great stress on the difference between the Xenias with fringed tentacles (*e. g. X. pulsitans* and *X. brunnea*) and those with tentacles that are minutely warted (*X. elongata*, and *X. ochracea*), and suggested that the latter should be placed in a distinct genus, *Paraxenia*.

He gave a detailed account of the colours of his four species, showing that there is a great diversity in the colour of specimens which he considered to be representatives of distinct species. A remark he made on the specimen found off Warrior Island, Torres Straits, which he called *X. pulsitans* is of special interest (*l. c.* p. 197). He said that it has expanded tentacles over an inch in diameter, and that "all the eight tentacles move synchronously, opening out and contracting in a continuous measured rhythm—like the pulsating contractions of a jelly-fish."

This extraordinary behaviour of a *Xenia* seems to be similar to that of a grey *Xenia* of the Red Sea, which Dr. Crossland informs me in a private letter, recently received, "rapidly opens and closes its tentacles."

The only other record of a species from this region is that of *Xenia florida* off Port Denison (Kükenthal, 1902, p. 648).

On the western side of Australia (Abrolhos Islands) there is a record by Miss Thorpe (Mrs. Hunter) of three varieties of *Xenia*—*X. blumi* var. *pelsarti*, *X. ternatana* var. *littoralis*, and *X. depressa* var. *kükenthali*. The principal difference between these varieties is in the characters of the pinnules; in other characters they are very much alike; and although we are grateful for a very full and careful account of the characters of the specimens, there may be still some doubt whether they are not varieties of only one species.

ANTARCTIC OCEAN.—*Xenia antarctica* was obtained by the Valdivia expedition at a depth of 457 metres east of Bouvet Island and described by Kükenthal (1906, p. 19). It has large polyps (10–12 mm. in length) and no spicules. It is distinguished from all the other species with large polyps in having only one longitudinal row of 14 pinnules on each side, and a number of very low wart like processes scattered irregularly on the oral surfaces of the tentacles.

X. depressa was described by Kükenthal (1914, p. 6) from a specimen in the Vienna Museum. It was said to be related to *X. bauiana* (May).

ARCTIC OCEAN.—Jungersen (1892) described an Alcyonarian from 538 metres, N. 66°16′, W. 25°20′, under the name *Ceratocaulon wandeli*. According to Kükenthal (1906, p. 22) this is a *Xenia* closely allied to *X. antarctica*.

The list of species of *Xenia* as amended is as follows:

1. *Xenia umbellata*, Ehrb.

This species is widely distributed in the Red Sea, Indian Ocean, Malay Archipelago, Australian Barrier Reef and Pacific Ocean. It has large polyps and a low degree of contractility. Spicules absent or present. It includes the following as synonyms: *X. fuscescens*, Ehrb., *X. coerulea*, Ehrb., *X. bauiana*, May, *X. sansibariana*, May, *X.*

tumbutuana, May, and *X. quinqueserta*, May. *X. medusoides*, May, and *X. depressa*, Kükenthal, are probably varieties of this species.

2. *Xenia elongata*, Dana. Malay Archipelago.

This species has very large polyps. Spicules absent.

3. *Xenia hicksoni*, Ashworth. Celebes.

This species may be a variety of *X. umbellata* but it has smaller polyps.

4. *Xenia plicata*, Schenk. Malay Archipelago and Australian Barrier Reef.

This species has smaller polyps than *X. umbellata* with relatively long tentacles. Numerous spicules.

X. blumi and *X. rubens* of Schenk may be regarded as synonyms of this species.

5. *Xenia crassa*, Schenk. Malay Archipelago, Barrier Reef and Pacific Ocean.

This species has smaller polyps and relatively shorter tentacles than *X. plicata*.

X. fusca, *X. viridis* and *X. membranacea* of Schenk are probably synonyms of this species. For further considerations of the relations of *X. plicata* and *X. crassa* see p. 156.

6. *Xenia multispiculata*, Kükenthal. Fiji and Tonga. This species has larger polyps than *X. crassa*, but seems to be related to it.

7. *Xenia garciae*, Bourne. Indian Ocean. This species has small polyps (1·8–3·5 mm.), and the outer rows of pinnules almost meet on the aboral side of the tentacles.

8. *Xenia novae-britanniae*, Ashworth. New Britain. This species has larger polyps (2·8–3·5 mm.) and larger tentacles than *X. garciae*, and the outer rows of pinnules are widely separated on the aboral side of the tentacles. (See Ashworth, 1900, p. 520.)

9. *Xenia ternatana*, Schenk. Ternate, Zanzibar ? and Ceylon.

This species is said to differ from all the species mentioned above in having only two longitudinal rows of pinnules.

10. *Xenia nana*, Hickson. Ceylon.

This is a dwarf species with very small polyps and only a single row of pinnules on each side of the tentacles.

The following species were found in deep water and seem to be quite distinct (see pp. 151, 154).

11. *Xenia crosslandi* (*X. rigida* of Thomson and Henderson) off Zanzibar.

12. *Xenia antarctica*, Kükenthal. Antarctic Ocean.

13. *Xenia wandeli*, Jungersen. Arctic Ocean.

The following species have been so inadequately described that their correct identification is impossible : *Xenia florida* (Lesson), *X. danae* (Verrill), *X. samoensis* (Studer), and *X. ochracea*, *X. brunnea* and *X. pulsitans* (Saville Kent).

The study of the large collection of specimens of this genus from the Barrier Reef has made the task of arranging them in clearly defined specific groups extremely difficult. The characters that have hitherto been used for systematic purposes have proved to be so variable that they are almost useless, and any system based upon them must be provisional and artificial.

Taking a general view of the collection, there seems to be a rough grouping into three sets :

(1) Those with large polyps (8–10 mm. in body length) and relatively feeble powers of contraction, which I have referred to *X. umbellata* (Ehrb.)

(2) Those with smaller polyps (6–8 mm.) relatively long tentacles (4–6 mm., and greater powers of contraction, which I have referred to *X. plicata* (Schenk).

(3) Those with still smaller polyps (4–5 mm.) and relatively shorter tentacles (2–5 mm.) and still greater powers of contraction, which I have referred to *X. crassa* (Schenk).

There is naturally some overlapping between these groups, and there are some specimens that it is difficult to place definitely in any one of these species, but unless the extreme step is taken of lumping them all into one very variable species, this plan seems to me the only one that can be adopted.

The characters I have given of *X. plicata* and *X. crassa* do not agree entirely with the account of these species given by Schenk, but the illustrations he gives of them in his plates ii and iii do represent the differences between the groups in this collection which seem to prevail.

The specimens in the groups agree in having numerous discoid or oval spicules 0·02–0·025 mm. in size and in having 3–4 pinnules in an oblique row. In *X. umbellata* 4 pinnules in these rows is not uncommon, in *X. plicata* 4 pinnules occasionally occur, in *X. crassa* there are very rarely more than 3 pinnules. I have not seen any tentacle with two pinnules in a row or more than four.

The number of pinnules in each longitudinal row is very variable. In the larger polyps of *X. umbellata* there are 24–29, in *X. plicata* 18–22, in *X. crassa* 12–18.

Xenia umbellata, Ehrenberg.

There are two specimens collected at A 4′ south of the anchorage on Low Isles which I have referred to this species.

The striking features about them are the relatively larger size and comparatively feebler contraction of the polyps than in the others, and by their superficial resemblance to the specimens of *Heteroxenia elisabethae* from the Wishart's reef close by.

They are not dimorphic and neither of them shows at the margin any young polyps devoid of pinnate tentacles. In this respect, then, they are quite distinct from *Heteroxenia*.

The difference between them and some of the specimens I have referred to *X. plicata* is not so clearly defined, but they differ from them in having larger and stouter polyps, longer and wider tentacles, longer pinnules and fewer spicules in the body-wall. The two specimens were labelled α and γ respectively by the collector. Specimen α seems to be fully expanded; specimen γ shows some contraction of the tentacles, which, instead of being straight and outstretched, are bent over the oral disc. The latter therefore looks more like some of the specimens of *X. plicata* than the former.

Specimen α.—Springing from an irregular base (about 25 mm. in length), with a wide membranous expansion attached to an old coral branch, there is a low capitulum (ca. 60 × 25 mm.) with a stalk visible on one side only about 5 mm. in height.

The polyps are fully expanded, showing no contraction of the body-wall, and the pinnules even on the smallest polyps are slender and pointed cones. The larger polyps in the centre of the capitulum have a body-length of 10 mm. and the tentacles are 6 mm. in length. It is difficult to count the number of pinnules in an oblique row, but the usual number is three. There are four in some places, but never less than three. There are about 25 in each longitudinal row.

The spicules are very numerous in the tentacles, including the pinnules, but in the body-wall they are much more scattered than in *X. crassa.* They are mostly round in outline and ·02 mm. in diameter, but there are a few ovals slightly larger than this in one diameter. They have a pale orange colour.

Specimen γ.—This specimen has a very small base, 15 mm. in diameter, detached from its support. From the base rises a stalk which divides almost immediately into four branches. In the longest of these branches the distance of the capitulum from the base is 25 mm. The total width of the four capitula together is about 40 mm.

The difference in form of the two specimens is very striking, the one with a wide spreading base and a very short or no stalk and the other with a small base and long stalks. This difference is probably only due to the adaptation of growth of the colony to the support on which the larva happens to have settled. If a colony can spread at its base it does so and grows laterally, but if the support is small it has to grow in height and form a stalk or stalks.

The largest polyps are 10 mm. in height but the tentacles are shorter than in α, the longest I have measured being only 5 mm. in length. The pinnules are all long and pointed, and arranged as in α in oblique rows of three or four. The number in a longitudinal row is only 18.

The spicules are similar to those of α, very numerous in the tentacles, scattered in the body-wall. There seem to be rather more ovals than in specimen α, but the majority are round and a little smaller than in *X. crassa.*

These specimens were collected on April 24th, 1929. Gonads were not present.

Xenia plicata, Schenk. (Plate II, fig. 5.)

This species was described by Schenk from a single specimen growing on a madrepore branch at Ternate.

In the Great Barrier Reef Expedition collection there are five specimens from Low Isles and some others from Maer Island and Batt Reef, which resemble most closely the type of this species, but, as some of them show variations from the type, they afford interesting material for the determination of characters which are variable, and therefore of little value for systematic purposes, and characters which are less variable or invariable.

According to the short definition of the species given by Schenk (1897, p. 67) the colony is in the form of a thick stem with a slight concave upper end from which the polyps arise. The long tentacles bear three rows of short round wart-like pinnules on each side and the axis of the tentacles is free from pinnules throughout its whole length. There are 18–22 pinnules in each row. The numerous spicules scattered throughout the colony are discs which measure from 0·015–0·02 mm.* in diameter.

The form of the colony seems to be useless as a specific character, as in this collection there are specimens with a simple stalk as in the type, a divided stalk, a very short stalk and no visible stalk.

The length of the tentacles of the full-grown polyps, the number of rows of pinnules and the number of pinnules in each row are fairly constant characters. The spicules are variable in shape as between rounds and ovals. The pinnules of this and other species

* In the text the figures given are 0·015–0·2 mm. I think the latter must be a misprint for 0·02 mm. The largest spicules in any Xeniid hitherto described are only 0·1 mm. in diameter.

of *Xenia* are described by Ashworth and Schenk as " warts " to distinguish them from the long slender pinnules of *X. umbellata* and other species, and these authors divide the species into three groups : I, with long slender pinnules ; II, with slender pinnules and warts ; III, with warts only.

The difficulty I had in determining the position of these Xeniids was that, although in the majority of the tentacles the pinnules were all warts, in some a few pinnules were long and pointed. The question then was, Do they belong to division II or III of Schenk's system ? In all other characters they are most closely related to *X. plicata,* which is placed by Schenk in division III.

There is no account of the appearance of these tentacles in the living specimens, but it is probable that in a healthy and fully expanded condition the pinnules are all or nearly all long and slender.

Description of the Specimens.

1. The Specimens from Low Isles.—Specimen A : The stalk arises from a base 20 mm. in diameter, and at a distance of 22 mm. from the base it divides into two branches. One branch has a maximum height from the base of 33 mm. and the other of about 30 mm. Both end convexly, and the expanded polyps of the two branches mingle to form what appears to be a single capitulum about 55 mm. in diameter.

The body of the larger polyps is 6 mm. in length and approximately 1 mm. in diameter when the polyps are fully expanded. The tentacles are very uniformly 6 mm. in length. The pinnules are arranged in oblique rows of three, and there are 18–20 pinnules in each row. The character of the pinnules varies a great deal. In most of the tentacles they are short round or dome-shaped warts. They vary so much in size in different tentacles and parts of the same tentacle that it is impossible to give a measurement of general application. In the middle of the tentacle a typical wart is about 0·15 mm. in height and 0·18 mm. in diameter. In some of the tentacles, however, there are pinnules which are slender and pointed at the extremity with a length of 0·4–0·6 mm. Between these and the ordinary warts every intermediate condition can be found. On the oral side of the tentacles there is a bare space between the pinnules which extends from the base almost to the extremity.

Specimen B : The base of this specimen is hour-glass-shaped, 32 mm. long by 10 mm. broad in the constricted part and 20 mm. broad in its widest part. From the base four very short stems arise, giving rise to a common capitulum 60 mm. in length. This specimen seems to be less contracted than the specimen A, the polyps are longer (5–7 mm. in height) and the pinnules are 4 in a row in the middle of the tentacles, 3 at the base and apex.

Specimen C is a long straggling colony 80 mm. in length with several bases of attachment. The greater part of it has no stalk, but at one end there is a stalk 12 mm. in height. The polyps resemble those of A more closely at one end and those of B at the other.

Specimens D and E are smaller than the others and have rather more contracted polyps.

Spicules are present in all these specimens and round or oval corpuscles approximately 0·02 × 0·025 mm. in size. They are found in large numbers throughout the superficial parts of the colony, including the tentacles and pinnules.

2. A specimen (Plate II, fig. 5) from Batt Reef, Patch 1, 7 miles E. of Low Isles, presents some difficulties. It is smaller than the others, and in some respects resembles *X. crassa,* suggesting that the separation of these species is artificial.

It differs from the specimens of *X. crassa* described in this paper in having relatively

long tentacles and larger spicules, mostly ovals. From a membranous expansion at the base there rises an undivided stalk expanding above into a capitulum 50 mm. in diameter.

The body of the polyps is 4–5 mm. in height and the long slender tentacles 4 mm. in length. The pinnules are blunt pimples about 0·3 mm. in length, *i. e* they are intermediate between low warts and the slender pointed pinnules. There are 3 pinnules in the oblique rows and about 16 in the longitudinal rows.

3. The specimens from the N.W. reef flat of Maer island (11th May, 1929) are most difficult to describe and to identify, but afford an instructive study of variation in the genus.

On a dead coral branch about 120 mm. long there are several patches of *Xenia* polyps, united in many places by a thin membranous expansion of the base which spreads over the coral. Only in one place can anything of the nature of a stalk be seen, and the greatest height of this on one side is only 4 mm. This place shows, when cut through, a typical syndete 7 mm. in height. Elsewhere the polyps seem to arise directly from the membranous expansion. The continuity of these clusters proves almost conclusively that we are dealing here with one species, but it is impossible to say for certain whether the whole series is the product of one larva.

The size and structure of the polyps vary so much in different parts of the clusters that a single definite statement on either of these features, such as could be given in a table, cannot be made.

On the edges of the clusters and standing isolated on the stolon there are some very small polyps. These are not siphonozooids, as they show the full complement of 8 small tentacles bearing wart-like pinnules.

One of the largest polyps was removed for examination from the middle of one of the clusters. The length of the body is 8 mm. and its diameter 0·4 mm.; the tentacles are 4 mm. in length. The pinnules in these tentacles are principally warts, but there are some conical or pointed ones at the extremity with a length of 0·2 mm. The arrangement of the pinnules in rows is difficult to determine, owing to a transverse constriction of the tentacles, the rows, particularly at the distal end, becoming distorted and confused. At the basal end of the tentacles there are clearly 3 wart-like pinnules in each oblique row, but at the distal end there can be clearly seen 4 pinnules in some of the oblique rows. The exact number of pinnules in the longitudinal rows is also very difficult to determine, but there are at least 20, and perhaps a few more in the outer row. The bare track between the rows of pinnules on the oral side of the tentacles is clearly seen over the proximal half, but is greatly constricted distally.

Selecting the largest polyps from another cluster I obtained different results. The body of the polyps is 6 mm. in length and nearly 1 mm. in diameter, the tentacles were 5 mm. in length, and nearly all of the pinnules of the outer longitudinal row are long pointed cones and up to 0·3 mm. in length.

The spicules are abundant in the ectoderm of body, tentacles and pinnules. They vary in shape from round to oval. The size of the larger discs is 0·025 mm. in diameter and of the ovals 0·02 × 0·025 mm.

On further examination of several polyps and their tentacles I have come to the conclusion that no specific difference can be established between these specimens and those from Low Isles.

In the spirit specimens the Maer Island variety seems to have relatively shorter tentacles and rather more pinnules in each longitudinal row. The pinnules may be a

little more contractile than in the Low Isles specimen, but no material differences can be seen in the size, shape or distribution of the spicules or in other characters of the polyps.

The spreading membranous expansion and almost complete absence of a stem are, in my opinion, characters of no specific importance, but dependent entirely upon age, the nature of the support and the conditions of the environment.

Xenia crassa, Schenk. (Plate II, fig. 4.)

A number of specimens collected by the expedition are most conveniently grouped together in the species *Xenia crassa* as amended above (p. 155). They may be described under the letters O, P, Q, R, S.

They were all found in shallow water off Low Isles. P and Q were found in the glades of the mangrove swamp, O and R on the Luana reef and S on the opposite side of the anchorage.

It is worthy of note that P and Q from the mangrove swamps have retained a pale blue colour. The others, which we may suppose were more exposed to the sun, are white or pale yellow.

As there is no information on the labels on the colour of these Alcyonaria when collected, I do not think this difference can be of any specific interest. All of these specimens were carefully examined, and a table constructed of their measurements and other characters.

They all had three oblique rows of pinnules, except that in some tentacles of Q there was a fourth in the row in the middle of the tentacle. The number of pinnules in each longitudinal row, which was very difficult to count in some cases, varied from about 12 to 18 but did not exceed 18.

In all the specimens there were numerous spicules in the body-wall, axis of the tentacles and in the pinnules. They were round or oval in shape, and varied from 0·015 to 0·02 mm. in size.

In other characters there were wide variations, so wide indeed that under the old system several distinct species would be proposed for them. The specimen Q from the mangrove swamp afforded a most instructive example of what the range of variation in a species may be in preserved specimens.

This specimen is attached to a branch of dead coral. It consists of two capitula connected together by a thin band 12 mm. extending from the membranous expansion of the base. The capitula are 30 mm. and 23 mm. respectively in diameter. There is no stalk at the base of either capitulum, but the syndete in the larger one is about 4 mm. thick in the middle.

There can be no doubt whatever that the two capitula are parts of the same colony, and yet the polyps differ from one another to a remarkable extent, as shown in the following table:

	Diameter.	Body length of polyps.	Length of tentacles.	Pinnules.
Capitulum I	30 mm.	8 mm.	5·5 mm.	0·45 mm., long and pointed
Capitulum II	23 ,,	2·5 ,,	2 ,,	Very low warts.

These are measurements of a typical polyp taken from the centre of each capitulum, but a critical examination of the larger capitulum shows that there are several smaller polyps near the margin with low wart-like pinnules as in the smaller capitulum.

This specimen also throws light on some other characters which have been used for the determination of species. Schenk and May give as a distinguishing feature of *X. rubens* that there are five or six irregular rows of little warts scattered over the inner side of the tentacles, and May characterizes *X. bauiana* and *X. medusoides* by having pinnules on both sides of the tentacles. Both these conditions are found in some of the polyps of this specimen. In the fully expanded tentacle the outer longitudinal row of long pointed pinnules is always on the edge of the tentacles, the aboral surface being quite free. In the polyps that are more contracted the wart-like pinnules appear to be scattered irregularly on the oral side of the tentacles; and in some of the most contracted tentacles pinnules seem to be irregularly arranged all round the axis, as they are said to be in May's *X. medusoides*. It is true that in *X. bauiana* and *X. medusoides* the pinnules are said to be long and slender, whereas in these forms they are usually wart-like in shape; but the great variety in the forms of pinnules in specimen Q leads me to the conclusion that the appearance of pinnules on the aboral side of the tentacles is always caused by contraction. The specimens I have attributed to this species from the Barrier Reef were as follows:

Specimen O: This specimen has a capitulum 42 × 38 mm. There is a short stalk not exceeding 10 mm. in height springing from an almost circular compact base (25 mm. in diam.). The polyps are densely crowded and somewhat contracted. The body length is about 5 mm., the tentacles 4 mm. in length, the pinnules of some of the polyps long (0·3 mm.) and pointed. The spicules have a pale orange colour. The colour of the specimen in spirit is dull white.

Specimen P: This is the most completely contracted specimen of a *Xenia* I have seen, and I refer it to this species with some hesitation. It has a capitulum 21 × 25 mm. on the end of a thick stalk 8 mm. in height springing from a wide membranous base, spreading over the surface of a branch of *Porites* to which the colony is attached.

The body-wall of the polyp is folded and contracted down to a height of not more than 1 mm.; the tentacles are 1·25 mm. in length; the pinnules are very short and blunt.

The spicules have an orange-brown colour like those of specimen O.

The colour of the colony in spirit is pale blue.

Notwithstanding the very striking differences between this specimen and others, I am inclined to the view that its peculiarities are all due to contraction. It has, like the others, three rows of pinnules on each side of the tentacles, and there are from 15–18 in each longitudinal row. There is nothing in the shape, size or distribution of the spicules to distinguish this specimen from the others.

Specimen Q has been described above. It was found in the same mangrove swamp as Specimen P.

Specimen R (Plate II, fig. 4): This specimen, found in close proximity to specimen O, closely resembles it in every respect, except that it seems to be rather more contracted. In my original notes, made without reference to other specimens, I put down the statement that "the pinnules are low warts." On comparing it again with specimen O I find no reason to alter this statement, as I can find no polyps with pinnules as long or as pointed as they are in some of those in specimen O.

If we were to adopt the key plan of Kükenthal (1902) and other authors these two specimens would be placed in widely separated species.

Specimens: In this specimen there are four main stalks springing from an irregular base of attachment about 14 mm. in diameter. The highest stalk is 10 mm. in height, but seems to break up into a few secondary branches. The combined heads of these branches form a capitulum about 35 × 20 mm. in extent.

This specimen differs from the others not only in the more profuse branching of the stalk, but in characters which may be due to a different effect of contraction. The body-wall of the polyps is very short, the longest being 2–3 mm. and in many of them only 1 mm. The tentacles are also very short, none of them exceeding 2 mm. in length, but the pinnules seem to be all fully expanded, being the longest I have observed in the group, and in some cases 0·6 mm. in length and sharply pointed at the extremity.

The Genus CESPITULARIA, *Milne-Edwards*.

This genus was revised by Kükenthal (1902, p. 657). The principal characters are that the colony is dendritically branched and that the margin of the capitulum is not sharply defined, the polyps (*i. e.* the anthocodiae) arising not only from the summit of the branches, but in gradually diminishing numbers down their sides (see Plate I, fig. 2; Plate II, fig. 6).

Five species have hitherto been described:

Cespitularia mollis described by Brundin (1896, p. 4) from 120 metres of water in the Korea Straits; *C. multipinnata** and *C. subviridis** by Quoy and Gaimard from the Pacific Ocean, and *C. taeniata* and *C. coerulea* by May from Mozambique and Zanzibar respectively.

Three specimens of *C. coerulea* were also described by Thomson and Henderson (1906, p. 415) from Zanzibar. To these species it is now proposed to add two new ones, *C. wisharti* and *C. mantoni*, from the Great Barrier Reef.

C. mollis must be regarded as a distinct species not only on account of its exceptional geographical and bathymetrical position, but on account of the presence of spicules which are twins, quadruplets and hour-glass shaped (up to 0·05 mm. in size), sparsely distributed in the coenenchym and other characters.

All the other species are found in shallow tropical waters, and none of them have spicules with the same characters as those of *C. mollis*.

Spicules have not hitherto been described in any other species, but in the case of *C. multipinnata* and *C. subviridis* some very unsatisfactory figures of spicules are shown in the plate illustrating the type-specimens. It seems probable, therefore, that the type of *C. multipinnata* had spicules, although very improbable that they were spindle-shaped, as shown in the drawing. The type of *C. subviridis* was probably a *Xenia* (see p. 163).

C. mantoni is a new species distinguished by its very large spicules (Text-fig. 5, p. 168).

C. wisharti is a new species which resembles *C. multipinnata* in having numerous wart-like pinnules between the lateral rows, but has no spicules.

The Zanzibar species (*C. coerulea*) and the Mozambique species (*C. taeniata*) have no spicules, and there are no pinnules on the tentacles between the lateral rows. They differ from one another in minor characters, but may prove to be identical.

* These two species were described under the generic name *Cornularia*.

The species described and figured by Quoy and Gaimard as *Cornularia subviridis*, and subsequently referred to the genus *Cespitularia* by May, is not in my opinion a member of this genus at all. Neither the description nor the figures (Plate XXII, figs. 1–4) of the type suggest that it is branched or dendritic in form, and as it was said to be a foot in expanse it was certainly not a juvenile stage of a branched adult.

It has the appearance of an ordinary *Xenia*—probably *X. umbellata*—and the only point in which it has a remote resemblance to a *Cespitularia* is that one or two polyps are shown a little below the margin of the capitulum, but even in this respect it is unlike a typical *Cespitularia*, because in this genus the polyps below the summit of the branches are more numerous, extend further down the branch, and are smaller in size than those above them.

A specimen supposed to be a variety of *C. subviridis* described and figured by Quoy and Gaimard may be dimorphic and a *Heteroxenia*. It is certainly not a *Cespitularia*.

Notes on the Genus Cespitularia.—The generic name *Cespitularia* was founded by Valenciennes (in MS.) for the type-specimen of *Cornularia multipinnata* Q. & G. This specimen has never been satisfactorily described, but the generic name was accepted by May (1900, p. 89), and two new species supposed to belong to the same genus were added.

Kükenthal's definition of the genus given above is satisfactory for *C. mollis*, *C. taeniata* and *C. coerulea*, but is very unsatisfactory as a description of the type of *C. multipinnata* as it is figured by Quoy and Gaimard.

I have accepted the generic name with some hesitation on that account, but only on the assumption that some errors have crept into the description of the type species.

The species of the genus I have examined are distinguished from *Xenia* by the character that the polyps are more contractile, and that very often they are so far retracted as to be indicated only by low verrucae. From the descriptions of the other species this may be an additional diagnostic character.

None of the species are dimorphic, and in all the specimens examined the ventral and lateral mesenteric filaments are absent.

Cespitularia multipinnata, Q. & G.

Some confusion has arisen on account of the transposition of the description of the figures of *Cornularia multipinnata* and *C. subviridis* by Quoy and Gaimard. At the end of vol. iii there is a list of errata stating that the figures on pl. xxii, figs. 1–4, illustrate *Cornularia subviridis*, and on pl. xxii, figs. 5–7, illustrate *C. multipinnata*, and not as printed in the description of the plate.

The species has not been obtained since the voyage of the "Astrolabe," but has been referred to the genus *Cespitularia* by May (1900) and by Kükenthal (1902, p. 659) on the strength of the original description and figures by Quoy and Gaimard. If it is correct to refer the specimens obtained by the Barrier Expedition to this species, it must be assumed that the figures of the type are not quite accurate in several respects.

In the first place the spicules are drawn in the form of spiny spindles about 3 mm. in length. No statement is made as to the enlargement of any of the figures, so that we are left in the dark as to the actual size of these spicules, but neither the Barrier Reef specimens of this species nor any other known species of the family Xeniidae have

spindle-shaped spicules. All that it seems safe to assume is that the type had small spicules.

Kükenthal (1902, p. 660) says that there are " zahlreiche Pinnulae in 3–4 unregelmässigen Reihen auf der Innenseite der cylindrischen Tentakel."

In the original figures there are only a few scattered pinnules on the inner side of the tentacles between the two outer rows. There is no indication of rows of pinnules, regular or irregular, between the two lateral rows. I have not seen anything in any Xeniid corresponding with the original figure of the tentacle of the type.

The two specimens which I have referred to this species were collected on Three Isles about 75 miles north of Low Isle. They were labelled " Xeniid-like forms " ω and ω^2 respectively.

The character of the branching of both these colonies is better expressed by the term shrubby than dendritic (baumförmig), but in both of them the ramification is much more profuse than in any specimen of a true *Xenia* that I have seen.

Moreover the branches are not terminated by a capitulum with a well-defined margin, but the polyps (*i. e.* anthocodiae) are scattered irregularly and of various sizes over the upper part of the stalk in the longer branches or the whole of the stalk in the shorter branches (Plate II, fig. 6). There is so much variety in the size of the polyps that it is difficult to give measurements that have any exact meaning. If one of the largest polyps on one of the branches be taken, the body-wall is 2 or 3 mm. in height and 1·5 mm. in diameter, but other polyps on the same branch and of the same diameter have a height of less than 0·5 mm. On every branch there are smaller polyps with small but fully developed tentacles with no appreciable body-wall at all, the crown of tentacles being flush with the surface of the branch.

The largest tentacles are about 4 mm. in length, but the tentacles show many degrees of contraction. In a tentacle which seems to be fully expanded there is on each side an outer row of about 15 pointed pinnules, reaching a maximum size of 0·5 mm. On the oral surface of the tentacle there are numerous pinnules varying in shape from short pointed pinnules to low warts. These pinnules do not usually seem to have an orderly arrangement, but in some places there is roughly a series of four in an oblique row on each side. There may be also at the base a short space between the rows free from pinnules.

In most of the tentacles the pinnules are low warts scattered quite irregularly over the oral surface of the tentacle.

In both specimens there are numerous spicules in the body-wall and tentacles and in the stalk. They are mostly oval in shape and have a length of 0·03 mm. and a breadth of 0·025 mm. They are a trifle larger than the spicules in most of the species of *Xenia.* No mention is made in the literature of the presence of spicules in this species, but small spiny spindle-shaped spicules are figured by Quoy and Gaimard in the plate illustrating the type-specimen.

The two specimens are very much alike in general appearance, but in specimen ω the polyps are rather more contracted than in specimen ω^2.

In ω there is a very irregular base from which rises a very short stalk, breaking up almost immediately into numerous branches which again branch irregularly. The height of the colony is about 50 mm.

A careful examination of the polyps, the tentacles, the pinnules and the spicules does not show any material difference from the characters of these structures in specimen ω^2.

Cespitularia multipinnata ? juv.

A small specimen was found by Dr. Manton on Escape Reef in July, 1929, which may be a young stage of *C. multipinnata*. Escape Reef is on the outermost margin of the reef platform.

The specimen has a base of attachment 20 by 10 mm., and its greatest height is about 15 mm. It has a very short stalk, which divides into a number of short, lobate branches. As in other specimens of *Cespitularia* there is no clearly-defined margin to the capitula, small scattered polyps arising right down to the base. The polyps are very much smaller than they are in the specimens described above, and many of them are very slightly contracted. In the most fully expanded polyps the body-length is 1·25 mm. and the diameter 0·75 mm. The tentacles are 0·75 mm. in length.

There is a single row of 9 pinnules on each side of the tentacles and of these 4 are short and wart-like, and the distal 5 are long and digitiform with a maximum length of 0·2 mm.

There are numerous disc-shaped spicules in the polyps and in the stalk with a diameter of 0·025–0·03 mm.

The colour of this specimen, when alive, was blue. No gonads were observed.

The difference in the character of the tentacles of this specimen and of the type might appear to justify the proposal of a new species. It is not strictly speaking multipinnate. The general resemblances in other respects suggest that the median wart-like pinnules of the type may not appear until a later stage in growth. A point of some interest in this connection is that the spicules are all disc-shaped, and just that little bit larger than the spicules of most of the species of *Xenia*, which was noted in the larger specimens from Three Isles.

Cespitularia wisharti, n. sp. (Plate I, fig. 3.)

Two specimens belonging to this genus were found on Wishart's Reef in Low Isle (23.v.29). In general form and mode of growth they are similar to the specimens of *C. multipinnata* described above, but differ from them in several characters.

The colour in spirit is pale yellow, in striking contrast to the greenish-grey colour of the other species. The polyps are decidedly more fully expanded but smaller. The substance of the colony is soft and flabby, and there are no spicules either in the polyps or in the stalk.

The absence of spicules in the Xeniidae has usually been regarded as a negligible character in the determination of species, as it may be due to prolonged immersion in a preservative which is acid in reaction.

When I found that the spirit in which these specimens were preserved gave a slightly acid reaction, whereas the spirit in which the specimens of *C. multipinnata* were preserved was neutral, it seemed possible that this accounted for the absence of spicules in *C. wisharti*. It did not seem probable, however, that this slight acidity could account for the total absence of the spicules throughout the colonies.

To test the matter further some polyps and coenenchym of *C. multipinnata* were treated with weak HCl for some days and subsequently stained and mounted in balsam. These preparations were compared with preparations of *C. wisharti* similarly stained and mounted. The difference between them was striking. In the former spaces in the

epithelium were observed, which corresponded with the shape and size of dissolved spicules, and the epithelium was also ruptured in places where the gas had escaped. No such spaces were seen in the epithelium of the latter.

The conclusion therefore is that in this case at least, the absence of spicules is a good specific character.

The specimens are about 90 × 40 mm. and 80 × 20 mm. respectively in expanse and they are both about 40 mm. in height. Neither of them has a simple base of attachment. One of them has five quite distinct bases and the other two, all irregularly circular in shape, and from 10–15 mm. in diameter. The lower branches from these bases completely fuse, so that above the bases there is one indivisible colony. There seems to be no reason to suppose that this is due to the fusion of colonies which, in a younger stage, were distinct; but, as the supporting coral, or whatever it was, is missing, the manner in which the original colony spread cannot be determined.

The combined stalk from these bases gives rise to numerous columns dividing into lobate processes about 10 mm. in diameter and 40 mm. in height.

There are numerous polyps on the ends of these processes, fewer at the sides, and there are a few small stray polyps right to the base of the processes (Plate I, fig. 2).

The largest polyps are 1·5–2 mm. in height and about 0·6 mm. in diameter, and the tentacles are 1·6–2 mm. in length.

The difference in size, as expressed in figures, of these polyps and of those of *C. multipinnata* does not seem very considerable, but these specimens are clearly more fully expanded than the others, and probably the difference between them is still more pronounced in the living fully expanded condition.

On the oral side of the tentacles there are numerous pinnules, varying from long pointed forms 0·5 mm. in length to low warts. At the base of the tentacles the pinnules are sometimes arranged in two rows on each side with a space between them; in the middle there is no definite arrangement, but there are 4–5 pinnules across the width of the tentacle, and at the apex there are 4 or 5 pinnules in a single longitudinal row on each side with a broad space between them.

This seems to be the most usual arrangement of the pinnules, but there are some variations of it which may be due to contraction.

Cespitularia wisharti ? (Plate II, fig. 7.)

A specimen from an unknown locality collected by the Expedition is marked "π ? ?," signifying, I suppose, that it might be the same species as the specimen of *C. wisharti* which was marked "π." It is adherent to a branch of dead coral, and consists of two parts connected together by a cylindrical band 5 mm. in diameter, only partially attached below to the coral, the whole being 45 mm. in length. The larger part is about 20 mm. wide by 15 mm. in height, and appears to be a typical *Cespitularia* colony with short lobes; the smaller part bears two short lobes about 8 mm. in height. Many of the polyps are greatly contracted, and some of them retracted into verrucae. The largest polyps, which are undoubtedly considerably contracted, have a body-length of 1 mm. and tentacles 0·5 mm. The tentacles are so much contracted that it is difficult to determine the exact arrangement of the pinnules. They are, however, certainly multipinnate, and in one polyp that was exceptionally well expanded the arrangement was as follows: at the apex of

the tentacle there were three pinnules in a single longitudinal row, with a space between them; in the middle of the tentacle there were in addition to the lateral pinnules a few low mound-like pinnules scattered about between them; at the base the median scattered pinnules were absent. The longest pinnules measured were only 0·07 mm. in length. There were no spicules in any part of the colony.

Another small specimen marked "π ?" and with a label marked "A 14 ? 11.iv.29" may provisionally be referred to this species. If the reference, A 14 = A 5 of the map, is correct, the specimen was found in the neighbourhood of the anchorage on Low Isle, and therefore not far from Wishart's Rock.

The specimen is remarkable in having the polyps more fully expanded than they are in any specimen of the genus I have seen.

It is 30 mm. in length, and divided by a short band into two parts as in the specimen described above. The larger end is 12 mm. wide and has four short lobes with the characteristic features.

The largest polyps have a body-length of 1 mm. but the slender tentacles are 2 mm. in length, and many of the delicate filamentous pinnules reach the extraordinary length of 0·6 mm.

The contrast between the tentacles of this specimen and of the other small specimen mentioned above is very striking. With a body-length of the polyp of approximately the same size, the tentacles of the former are 0·5 mm., of the latter 2 mm. in length, and the pinnules of the former 0·07 mm., and of the latter 0·6 in length.

There can be no doubt that the two specimens belong to the same species, and that this difference is only an instructive example of the contractility of the tentacles.

Cespitularia mantoni, n. sp. (Plate I, fig. 3.)

The single specimen for which I propose a new specific name was found by Dr. Manton in July, 1929, on Ruby Reef, a reef situated on the outermost margin of the Barrier platform.

It has a general resemblance, in spirit, to the small specimen of *C. multipinnata* found on the neighbouring Escape Reef, and like that specimen it was blue in colour when alive.

Miss Manton's note, however, " not the same species as that on Escape Reef," called for a detailed examination of the two specimens, and this led to the discovery of the very large spicules of this species and a confirmation of Miss Manton's field observation.

The specimen has an oval base of attachment 30 × 20 mm. There is a well-marked stalk about 10 mm. in height giving rise to about eighteen lobes of a typical *Cespitularia* character. They are about 10 mm. high by 8 mm. in diameter, irregular and discrete, and form a capitulum about 40 mm. in diameter. Many of the polyps are considerably contracted. The largest have a body-length 1·75 mm., and the most fully extended tentacles are less than one 1 mm. in length.

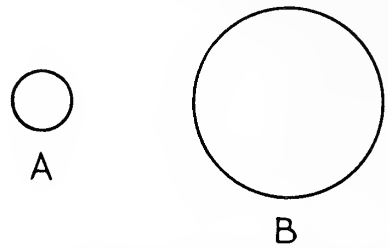
These small tentacles have a row of 4 or 5 pinnules on each side, with a broad space between them on which I can see no evidence of wart-like pinnules.

The most remarkable feature of the species is the enormous size of the spicules. Whereas in most species of the Xeniidae which have spicules the maximum size is 0·02–0·025 mm., in this species they are 0·1–0·12 mm. in diameter. They are therefore

four to five times greater in diameter than the spicules of any other species, and are quite visible to the naked eye in a section of the coenenchym (Text-fig. 5).

They are not very numerous nor of the maximum size in the tentacles and body-wall of the polyps, but in the coenenchym rows of these large brown spicules can be seen running parallel with the coelentera of the polyps. They are dark brown in colour and when isolated seem to be always round in outline, but, in some places, the round discs are fused together into irregular lumps.

The specimen was male with gonads 0·15 mm. in diameter.



TEXT-FIG. 5.—These circles are drawn to scale to show the relative sizes of the spicules of A, *Cespitularia multipinnata* from Escape Reef, and of B, *Cespitularia mantoni* from Ruby Reef. Both these reefs are on the Outer Barrier.

THE GENUS HETEROXENIA, *Kölliker*.

The only definition of this genus that is necessary at present is: Xeniidae with dimorphic polyps. Possibly at some future time the S. African species may find a place under a new generic name; but it seems a better plan to keep them all together until our knowledge is extended.

The type of this genus is *Heteroxenia elisabethae*, Kölliker (1875), which was found at Port Denison, Queensland; other specimens attributed to the same species were obtained by Haddon from Torres Straits and by the Great Barrier Expedition from the Low Isles.

Ashworth (1899), Bourne (1895) and Thomson and Henderson (1906) have given the same name to specimens from Zanzibar, and Light (1915) records the species from the Philippine Islands.

Kükenthal (1902, p. 653) considered that the specimens described by Ashworth and by Bourne were distinct from Kölliker's type-species, and referred them to a new species, *X. ashworthi*, on the character of 3 pinnules in a row on the tentacles, instead of 4, as in the type. Thomson and Henderson in their description of specimens from Zanzibar state that the number of pinnules in a row is 4, but occasionally there are 5. Ashworth also distinctly states that although 3 pinnules in a row is the usual number, there may be 4 in a row at the base of the tentacles. May (1900, p. 85), who examined specimens from Zanzibar collected by Sander and Stuhlmann, said there are four rows of pinnules. If it could be shown that the specimens of this genus from the Red Sea and Zanzibar had invariably 3 pinnules in a row, and those from the Australian waters invariably 4, there would be some reason for considering the former to be specifically distinct from the latter, but as specimens from both localities have been described with three and four rows, this specific distinction cannot be maintained, and *Xenia* vel *Heteroxenia ashworthi* must lapse.

Kükenthal considered Kölliker's *Heteroxenia elisabethae* to be synonymous with Ehrenberg's *Xenia fuscescens*—a conclusion with which I cannot agree (see p. 173).

Other species which must be referred to the genus *Heteroxenia* are *H. capensis*, Hickson, from the Cape of Good Hope, *H. rigida*, May, from Mozambique, and *H. uniserta*, Kükenthal, from Simon's Bay.

Heteroxenia elisabethae differs from the other dimorphic species by the very obvious character that the siphonozooids in preserved specimens project 2–9 mm. from the surface of the stalk. The autozooids also appear to be less contractile than they are in the other species.

As *H. capensis* and the other two species, if they are distinct, exhibit a dimorphism similar in general characters to that of other dimorphic Alcyonaria, the whole controversy on the value of dimorphism as a character for generic importance depends upon the facts and interpretation of the characters of *H. elisabethae*. I have therefore made a careful study of the structure of the well-preserved specimen of this species collected by the Expedition, and compared it with that of all the other specimens I have been able to obtain.

In the collection made by the Barrier Reef Expedition there is one specimen of *Heteroxenia elisabethae* which I have described in detail on p. 173.

I have also examined three specimens of the same species collected by Prof. Haddon in Torres Straits, and six specimens collected by Dr. Crossland off Zanzibar.

The smallest specimen (from Zanzibar) is only 15 mm. in height, and the spread of the capitulum is only 12 mm., but the dimorphism of the polyps is as clearly seen as in the larger specimens.

With these specimens I have compared the descriptions and measurements of specimens described by Kölliker (1874), Ashworth (1899), May (1900), Kükenthal (1904), Thomson and Henderson (1906), and Cylkowski (1911), and I have constructed a table of the characters usually employed in the determination of the species of Xeniidae from the results thus obtained. My first object was to determine whether the Xeniids which have been described under this name represent only one species, two species or more than two species.

If there is only one species its geographical distribution is remarkable. It occurs in the Red Sea and off Zanzibar, but has not been found hitherto off Ceylon or in the archipelagos of the central part of the Indian Ocean.

It is found in the Philippine Archipelago (*fide* Light, 1915), and on the reefs of the East coast of Australia and Torres Straits. It may occur in the Malay Archipelago,* but no specimens have yet been recorded from that region, nor from Singapore. It does not occur so far as we know in any of the archipelagos of the Pacific Ocean.

If there is, as the evidence seems to prove, a very wide sea area between the localities in the east and in the west where it does not occur, it might be expected that some specific distinction between the specimens of the two regions would be found. All that can be said is that, at present, no such specific distinction has been found, and the species *Heteroxenia elisabethae* should be considered to be indivisible.

This statement is based on the consideration of the characters in my table referred to above and the following may be regarded as a summary of this table.

Size.—The largest specimen from the Australian region that has been described is the

* See Appendix, p. 177.

type from Port Denison. According to Kölliker's figure it was about 180 mm. in diameter across the capitulum and the stalk was 80 mm. in height. The smallest specimen from this region in my collection is only 15 mm. across the capitulum, and has a stalk 8 mm. in height.

There are not many data as to the actual size of the larger specimens from the Red Sea and Zanzibar areas. One specimen measured by Thomson and Henderson (1906, p. 413) had a capitulum with a diameter of 35 mm. and a stalk 25 mm. in height. There are reasons for believing that some of the specimens from the Red Sea were much larger than this one. The smallest specimen in the Crossland Collection has a capitulum 15 mm. in diameter and a stalk 10 mm. in height. There is no doubt that Kölliker's specimen from Port Denison is the largest that has been described. Apart from this there does not seem any reason to suppose that the specimens from the Australian region are larger on an average than those from the Red Sea region.

Size of the autozooids.—There is also a wide range of variation as regards the size of the autozooids. From the Australian region the autozooids of Kölliker's specimen were 20–40 mm. in height, of the specimen described in this paper 10 to 15 mm., and of some specimens in Haddon's collection only 5–7 mm.

From the Red Sea and Zanzibar region the autozooids of Ashworth's specimen were 10–25 mm. in height, of Thomson and Henderson's 15–22 mm., of Kükenthal's 20–40 mm., of Cylkowski's 3–50 mm.

There is clearly some correlation between the size of colony and the size of the autozooids: the larger the colony, the larger the autozooids.

If we take the expanse of the capitulum as the standard of the size of the colony and compare it with the size of the body of the largest autozooids, we get the following results:

	Diameter of capitulum.	Length of largest autozooids.
Kölliker's specimen	130	40
G.B.R.E. ,,	55	15
Haddon's ,,	25	5
Ashworth's ,,	about 30	25
Th. and H.'s ,,	35	22
Crossland's ,,	15	2

The figures given in these columns represent only the measurements of preserved specimens; no account is taken of the degree of contraction of autozooids, which, in some cases, is considerable. The autozooids of Haddon's specimens were obviously much more contracted than any of the others. If the measurements had been taken of the specimens alive in their natural position on the reef the figures would have been different, but I think there can be no doubt that a similar correlation between size of colony and size of autozooid would have been found.

The pinnules.—The tentacles of the autozooids in all the specimens of the species have numerous pinnules on both sides of the rachis. They are arranged roughly in oblique rows of three or four, and in longitudinal rows of 16–25 or more. In some cases the oblique rows are quite clear, but in others, particularly in those that are slightly contracted, the pinnules seem to be more unevenly distributed and the arrangement in rows is indistinct. It is always very difficult to determine with accuracy the exact number of pinnules in

every oblique row of a single tentacle, and still more difficult and time-absorbing to determine whether there are any variations in the number of pinnules in the oblique rows in the autozooids of a single colony.

Some authors in their descriptions of the species of the Xeniidae give a simple statement that the number of pinnules is 3 or 4 as the case may be.

Ashworth (1899), however, in his description of *H. elisabethae* from Zanzibar, says that the usual number of pinnules in a row is 3, but there may be 4 at the base of the tentacles. Thomson and Henderson (1906) in a description of specimens from the same locality say there are 4, but there may be 5. Cylkowski (1911) says there are 4, seldom 5 or 3 in specimens from Jidda.

When I first examined the specimen collected by the Great Barrier Reef Expedition I put down in my notes that there are 3 pinnules in an oblique row, but the number given by Kölliker for the type is 4. I endeavoured to find out some facts as to the variation in the number of pinnules by a careful examination of several tentacles. I took three autozooids from the middle of the capitulum and three from the periphery, dissected off the tentacles, and examined all of them by reflected and by transmitted light. The notes I made are as follows:

> *Median autozooids.*—1. At the base and at the extremity of the tentacles there are 2 in a row, in the middle there are 3.
>
> 2. All the tentacles have 4 pinnules in a row except at the base, where there are 3.
>
> 3. All the tentacles have 4 in a row in the middle, 3 at the base.
>
> *Peripheral autozooids.*—1. Distinctly 4 in a row in the middle.
>
> 2. At the base 3 or 4, in the middle 4, but in one tentacle there were not more than 3.
>
> 3. Some tentacles with 4 in a row, some with only 3.

From this evidence it is clear that the variation in the number of pinnules in a row is such that the separation of *H. ashworthi* from *H. elisabethae* proposed by Kükenthal is unsound.

Spicules.—According to Kölliker there were numerous spicules, 0·019–0·024 mm. × 0·01–0·015 mm. in size in the type-specimen. May, however, says that he could find spicules in only one of the specimens he examined. In the Great Barrier Reef Expedition specimen and in all the specimens in the Haddon collection I have examined there are numerous spicules approximately 0·025 × 0·02 mm. in size.

Bourne gives the size of the spicules of the specimen from Zanzibar as 0·02 × 0·01 mm. Thomson and Henderson say that in their specimens, also from Zanzibar, there are numerous spicules 0·001 mm. in diameter. (I think there must be a mistake or a misprint in this figure, as in the specimens of this collection which I have examined the spicules are at least 0·02 mm. in diameter.)

In the specimens called *X. fuscescens* by Kükenthal (1902, p. 654) the spicules are said to be present or absent, and in the specimens from Jidda, Cylkowski (1911, p. 4) says the spicules are absent.

Klunzinger (1877, p. 41) says the spicules of *X. fuscescens* are similar to those of *X. umbellata*, in which they are " 0·008 bis. 0·016–0·024 mm." in size.

According to my own observations the spicules of *H. elisabethae* are thin discs, oval or more irregular in shape with a maximum diameter of 0·025 mm.

The reported absence of spicules in some specimens is noteworthy. The spicules,

however, are often so thin and transparent that they may be easily overlooked, and if the preservative is acid in reaction they might be destroyed or rendered very inconspicuous. In any case the character of "absence of spicules" without confirmation cannot in this case be accepted as a sole ground for specific distinction.

Heteroxenia elisabethae, Kölliker.

MEASUREMENTS IN MILLIMETRES.

Locality of specimens and authority.	Height of autozooids.	Height of siphonozooids.	Length of tentacles.	Greatest diameter of spicules.	Number of pinnules in an oblique row.	Number of pinnules in a long row.
Port Denison, Kölliker	20–40	7–8	15	0·019–0·024	4	..
Torres Straits, Hickson	5–7	2–2·5	4–7	0·02–0·025	1, 2 or 3	18–20
Low Isles, Hickson	15	9	6	0·02–0·025	3 or 4	20
Zanzibar, Ashworth	10–25	2–5	4–5	0·02	3 or 4	16–24
,, Th. & H.	15–22	4–5	5·5–6·5	0·001 (?)	4	?
Sinai, Kükenthal	20–40	3–5	15	Present or absent	4	?
Jidda, Cylkowski	3–50	?	3–12	Absent	Rarely 3 or 5	..

Summary.—There is not any sound specific distinction between the *Heteroxenia elisabethae* of the Australian Barrier Reef and the *H. elisabethae* of the Red Sea and Zanzibar.

Three other species of the Xeniidae are undoubtedly dimorphic, and it may be observed that they all came from off the coast of S. Africa, and agree with each other in having a single row of pinnules on each side of the tentacles. They are: *H. rigida* (May, 1900, p. 80), which bore a label "Mozambique," with no record of depth, *H. capensis* (Hickson, 1900, p. 70), from 20 fathoms of water in False Bay, and *H. uniserta* (Kükenthal, (1906, p. 22), from 70 metres in Simon's Bay. May's specimen was said to be well preserved, and seems to have been fully expanded. The other two were evidently somewhat contracted, and it is possible if they had all been fully expanded some of the recorded differences between them would not have been apparent.

May's specimen which he called *Xenia rigida* must not be confounded with Thomson and Henderson's (1906, p. 413) species of the same name from Zanzibar. It was rather smaller than my specimen, but judging from the figure (May's pl. i, fig. 5), it was clearly dimorphic, although the siphonozooids are called polypbuds (Polypenknospen).

The autozooids attain to a length of 10 mm. and the tentacles to a length of 3 mm. The club-shaped siphonozooids are 4 mm. in height and 0·85 mm. in diameter at the upper end. The spicules are elliptic yellowish-brown scales 0·02 mm. in length.

The original description of *H. capensis* was not very full, but as I have still in my possession, and in good condition, the three series of sections which I made thirty years ago, I can now add a few details which are of importance in view of the controversy which has since arisen. There can be no doubt as to the dimorphism of this series. The differences between the autozooids and siphonozooids are quite as pronounced as they are in *Sarcophytum* or any other dimorphic Alcyonarian. This is shown by a study of the stomodaea of the two kinds of zooids and by other characters. In my original description I said that the siphonozooids are contracted. In my sections I find that some of them

project slightly into shallow pits on the surface, and it is probable that when the colony is fully expanded they do project slightly from the general surface. The sections also give some evidence that there may be rudimentary tentacles on the siphonozooids. The autozooids are decidedly smaller (6 mm.) than in *X. rigida*, but the tentacles are longer (4–6 mm.). The spicules are scarce in the coenenchym, absent in the polyps, and rarely more than 0·01 mm. in diameter.

Xenia uniserta of Kükenthal is also undoubtedly dimorphic. The excellent figures and description of the siphonozooids that he gave in his Valdivia report show that there is a striking similarity in structure between them and the siphonozooids of such a genus as *Paragorgia* or of a Pennatulid.

The autozooids are not so retractile as in *H. capensis*, and have a height of 9 mm. The tentacles are 3·7 mm. long, and the siphonozooids do not project from the surface.

Spicules are present throughout the colony, and are much larger (0·057 mm. in length) than in the other species.

These three species form a group which differs from the *H. elisabethae* in having only one row of pinnules on each side of the tentacles. The characters by which they differ from each other are not of sufficient importance to make it certain that they are specifically distinct, and as they all come from the same region it is probable they are only local varieties of one species. At present, however, only four specimens altogether have been described, and the question can only be definitely settled when by the examination of a number of specimens from one locality some idea can be obtained of their variability.

Heteroxenia elisabethae, Kölliker. (Plate I, fig. 1.)

In Ehrenberg's description of his species *Xenia fuscescens* in 1834 (p. 278) no mention is made of the occurrence of dimorphism of the polyps. Klunzinger (1877) reproduced a series of drawings made by Ehrenberg himself which show quite clearly both autozooids and siphonozooids, and said (p. 41) that they were intended for drawings of *X. fuscescens*. These drawings, however, were labelled "fusco-caerulea," not *X. fuscescens*, and all the specimens in the Berlin Museum were labelled "*X. umbellata*"; not a single one was found which was named *X. fuscescens*.

There is really no historical evidence that the type of *X. fuscescens* was dimorphic. Klunzinger said that except in the character of dimorphism *X. fuscescens* agrees with *X. umbellata*, but Kükenthal (1902, p. 642) places *X. umbellata* in a group with long pinnules, 3 in an oblique row, and *X. fuscescens* in a group with 4 pinnules in an oblique row. For reasons given elsewhere, I am convinced that this distinction for species is not sound, and consequently I am of opinion that *X. fuscescens* is a monomorphic form identical with *X. umbellata*.

The Expedition obtained only one specimen of this interesting species. It was found on Wishart's rocks on 23rd May, 1929.

It has a very short thick stalk, which is 10 mm. in height on one side, dwindling to 2 mm. on the other. When the colony was bisected it was found that the stalk is dome-shaped, having a height of 25 mm. in the middle, a maximum diameter of 30 mm. and a diameter at the base of attachment, which appears to be very much contracted, of 20 mm. The spread of the capitulum, including the autozooids, is about 55 mm.

The autozooids show signs of being slightly contracted. The largest of them have a

body-length of 15 mm. and a diameter of 1·75 mm. The tentacles are 6 mm. in length, and there are 3 or 4 pinnules in the oblique rows in the middle of the tentacles (see p. 171). There are about 20 pinnules in each longitudinal row.

The pinnules show various degrees of contraction; the largest are pointed at the extremity and 0·6 mm. in length.

The siphonozooids are numerous throughout the capitulum, roughly speaking about five or six times as many as the autozooids. They vary considerably in size, the largest being 9 mm. in height and 1 mm. in diameter. Each siphonozooid has 8 small tentacles about 0·2 mm. in length. These tentacles are folded over the oral area and difficult to observe in whole mounts, but after careful examination and dissection I cannot find any evidence that they bear pinnules.

Spicules are numerous in the autozooids, siphonozooids and stalk. The majority are thin discs having a maximum diameter of 0·025 mm. There are some twins, having a shape like a "cottage" loaf, and some smaller rod-shaped spicules. There are very few that are oval in shape. It seems to be a character of the spicules of this specimen that the outline is more irregular and the shapes more varied than in most of the Xeniids.

Gonads.—The coelenteric cavities of the autozooids bear numerous female gonads of various sizes up to a maximum diameter of about 0·75 mm.

The Genus SYMPODIUM, *Ehrenberg.*

Ehrenberg (1834, p. 285) referred a number of species to this genus, and among them were *S. fuliginosum* and *S. caeruleum* from the Red Sea. Klunzinger (1877, pp. 42, 43) gave a further account of these species and refers to the blue colour of the former. He also described *Anthelia glauca* and *A. strumosa* with a blue-green colour. Kükenthal (1904, pp. 39, 43) described these species more fully, but referred *S. fuliginosum* to the genus *Anthelia* and included *A. glauca* and *A. strumosa* in the same species.

From the descriptions of these authors it seems certain that in all these species the polyps are not retractile, that there are more than the two longitudinal rows of pinnules on the tentacles, and that the spicules, when present, are minute rods or discs. In 1916 Kükenthal announced that in *Sympodium caeruleum* the dorsal mesenteric filaments alone persist and the genus was transferred to the family Xeniidae.

I have found in the Cambridge Museum a small specimen of uncertain locality, but probably from Zanzibar, which agrees very closely with the description given by Kükenthal of *Anthelia fuliginosa*. The polyps are of approximately the same size, and the spicules are of the same size and shape. In this specimen the dorsal mesenteric filaments alone are present. *Anthelia fuliginosa* is therefore undoubtedly a Xeniid, and I see no reason why it should not be referred back to the genus *Sympodium*. In Kükenthal's 'Handbuch der Zoologie' of 1925 *Anthelia* is placed in his family Cornulariidae, but the only difference of any great importance between *Sympodium* and *Anthelia* in his account of these genera in 1916 is that the polyps of the former are more contractile than those of the latter.

I have recently (1930, p. 238) given reasons for suggesting that the generic name "*Anthelia*" should be suppressed.

The genus *Sympodium*, as it now stands, is a Xeniid, and the only character in which it seems to differ from *Xenia* is that the polyps do not form a syndete, but stand apart on a membranous stolon.

In my description of *Xenia nana* (1931, p. 84) I have given reasons for believing that a sympodium-like stage may occur in the development of the Xenias, and that this stage may persist for some time in growth, if there is room on the support for lateral expansion. It is an open question, therefore, whether the species referred to the genus *Sympodium* are not young stages or growth varieties of species of *Xenia*. As this question can only be answered by a special study on the reefs, it may be convenient to retain the genus *Sympodium*.

If this course be adopted a number of species which have been referred to the genus *Clavularia* should be transferred to this genus.

They seem to agree with the Xeniids in having more than one row of pinnules on the tentacles, in having minute spicules or no spicules at all, and in the non-retractile polyps. It is not known, however, whether they have the full number of mesenteric filaments. If it can be proved that they possess the dorsal pair of filaments only, their position is undoubtedly in the family Xeniidae.

In the more typical forms of *Clavularia* there is only one row of pinnules on each side of the tentacles; the spicules, when present, are usually relatively large and often spindle-shaped, and there is a full complement of 8 mesenteric filaments.

Among the species that should now be transferred to the Xeniidae are the following:

Clavularia garciae (Hickson, 1894, p. 341) with rod-shaped spicules. The type-specimen of this species has unfortunately been lost. *C. flava* (May, 1900, p. 43) with oval spicules. *C. gracilis* (May, 1900, p. 41) with no spicules. *C. crosslandi* (Th. & H., 1906, p. 404) with oval spicules. *C. zanzibarensis* (Th. & H., 1906, p. 404) with no spicules. *C. pulchra* (Th. & H., 1906, p. 404) with rod-shaped spicules. *C. mollis* and *C. pregnans* (Th. & H., 1906, pp. 406 and 407) with no spicules. The *Anthelia strumosa* of Ehrenberg was transferred to *Clavularia* by subsequent authors, but according to the accounts of the species given by May and Thomson and Henderson this species must also be a Xeniid. May states that the spicules of his specimen were "Stumpfe Stäbschen," 0·032 mm. in length, but Thomson and Henderson described the spicules as oval or roundish discs, 0·02 × 0·016–0·018 mm.

REFERENCES.

Ashworth, J. H. 1898. The Stomodaeum, Mesenterial Filaments and Endoderm of *Xenia hicksoni*. Proc. Roy. Soc. LXIII, pp. 443–446, figs. 1–3.

—— 1899. The Structure of *Xenia hicksoni*, etc. Quart. J. Micr. Sci. XLII, pp. 245–304, pls. xxiii–xxvii.

—— 1900. Report on the Xeniidae Collected by Dr. Willey. Willey's Zoological Results, Cambridge, pt. IV, pp. 509–530, pls. lii, liii.

Bourne, G. C. 1895. On the Structure and Affinities of *Heliopora coerulea*, Pallas. With some Observations on the Structure of *Xenia* and *Heteroxenia*. Philos. Trans. Roy. Soc. CLXXXVI, b, pp. 455–483, pls. x–xiii.

—— 1900. The Genus *Lemnalia*, Gray. Trans. Linn. Soc. Lond. Zool. (ser. 2), VII, pp. 521–538, pls. xl–xlii.

Brundin, J. A. Z. 1896. Alcyonarien aus der Zoologischen Museums in Upsala. Bih. svensk. Vetensk-Akad. Handl. XXII, Afd. IV, No. 3, pp. 1–22, pls. i, ii.

Cylkowski, B. 1911. Untersuchungen über den dimorphismus bei den Alcyonarien. Inaugural Dissertation, Breslau, pp. 1–47.

Dana, J. D. 1848. U.S. Exploring Expedition: Zoophytes, pp. x + 740, pls. i–lxi.

Ehrenberg, C. G. 1834. Beiträge zur Physiologischen Kenntniss der Corallenthiere. Phys. Abh. K. Akad. wiss. Berlin, 1832 [1834], pp. 225–380.

Haacke, W. 1886. Zur Physiologie der Anthozoen. Zool. Gart. Frankfurt, XXVII, pp. 284–286.

HICKSON, S. J. 1883. On the Ciliated Groove (Siphonoglyphe) in the Stomodeum of the Alcyonaria. Philos. Trans. Roy. Soc. (N.S.) CLXXIV, pp. 693–705, pls. l and li.
—— 1894. *Alcyonaria Stolonifera.* Trans. Zool. Soc. Lond. XIII, pp. 325–347, pls. xlv–l.
—— 1900. The Alcyonaria and Hydrocorallinae of the Cape of Good Hope. Marine Investigations in S. Africa, I, pp. 67–96, pls. i–vi.
—— 1903. The Alcyonaria of the Maldives, Part I. Fauna and Geog. Maldives and Laccadives, II, pp. 473–502, pls. xxvi, xxvii.
—— 1930. On the Classification of the Alcyonaria. Proc. Zool. Soc. Lond. 1930, pp. 229–252, text-figs. 1 and 2.
—— 1931. Three Species of Alcyonaria from the Gulf of Manaar. Bull. Madras Govt. Museum (N.S.) Nat. Hist. I, No. 2, pp. 79–89, text-figs. 1–3.
JUNGERSEN, H. F. E. 1892. Ceratocaulon Wandeli en ny nordisk Alcyonide. Vidensk. Medd. naturh. Foren. Kjøb. 1891 [1892], pp. 234–242, text-figs. 1–4.
KENT, W. S. 1893. *See* Saville-Kent, W.
KLUNZINGER, C. B. 1877. Die Korallthiere des Rothen Meeres. Berlin. Th. 1, pp. 98, 8 pls.
KÖLLIKER, ALBERT. 1865. Icones Histiologicae, pp. 181, 19 pls.
—— 1875. Die Pennatulide Umbellula und zwei neue Typen der Alcyonarien. Festschr. phys.-med. ges. Würzburg, pp. 1–23, pls. i and ii. (Pt. II. Heteroxenia, pp. 12–17, pl. ii.)
KÜKENTHAL, W. 1902. Versuch einer Revision der Alcyonarien. Die Familie der Xeniiden. Zool. Jahrb. Abt. f. Systematik, XV, pp. 635–662.
—— 1904. Ueber einige Korallentiere des Roten Meeres. Denkschr. med.-naturw. Ges. Jena, XI, pp. 31–58, pls. iv and v, text-figs. 1 and 2.
—— 1906. Alcyonacea. Wiss. Ergebn. Deutschen Tiefsee-Exped. 1898–1899, XIII, Teil 1, pp. 1–111, pls. i–xii.
—— 1911. Alcyonarien von den Aru-und Kei-Inseln. Abh. Senckenb. naturf. Ges. XXXIII, pp. 309–346, pls. xix–xxiii, text-figs. 1–83.
—— 1914. Alcyonaria des Rothen Meeres. Denkschr. Akad. Wiss. Wien, LXXXIX, Berichte der Kommission f. Ozeanographische Forschungen, pp. 1–33, pls. i–iii, text-figs. 1–27.
—— 1916. Die Gorgonarien Westindiens. Kap. 1–3. Zool. Jahrb. Suppl. XI, pp. 443–504, pl. xxiii, 26 text-figs.
—— and BROCH, H. 1911. Pennatulacea. Wiss. Ergebn. Deutschen Tiefsee-Exped. 1898–1899, XIII, Teil 1, pp. 113–576, pls. xxiii–xxix, text-figs. 1–295.
LAMARCK, J. B. P. A. 1816. Hist. nat. Anim. s. Vertèbres, II, pp. 409–410.
LIGHT, S. F. 1915. Notes on Philippine Alcyonaria. Philipp. J. Sci. X, Section D, pp. 155–167.
MARSHALL, A. M. 1883. Report on the Pennatulida Dredged by H.M.S. "Triton." Trans. Roy. Soc. Edinb. XXXII, pp. 119–152, pls. xxi–xxv.
MAY, W. 1900. Beiträge zur Systematik und Chorologie der Alcyonaceen. Jena. Z. Naturw. XXXIII, pp. 1–180, pls. i–v.
QUOY, J. R. C., and GAIMARD, J. P. 1883. Voy. "Astrolabe," 1826–29. Zoology, IV, pp. 390, 26 pls.
SAVILLE-KENT, W. 1893. The Great Barrier Reef of Australia. London, pp. xvii + 387. 64 pls. (col.), 1 map, text illust.
SCHENK, A. 1897. Clavulariiden Xeniiden, und Alcyoniiden von Ternate. Abh. Senckenb. naturf. Ges. XXIII, pp. 41–80, pls. ii–iv.
THOMSON, J. A., and HENDERSON, W. D. 1905. Alcyonaria. Ceylon Pearl Fisheries Suppl. Reports, Part III, pp. 269–328, pls. i–vi.
—— —— 1906. The Marine Fauna of Zanzibar and British East Africa—Alcyonaria. Proc. Zool. Soc. Lond. 1906, pp. 393–443, pls. xxvi–xxxi, text-fig. 85.
—— and MACQUEEN, J. M. 1908. Reports on the Marine Biology of the Sudanese Red Sea.—VIII. The Alcyonarians. J. Linn. Soc. Zool. XXXI, pp. 48–75, pls. v–viii, text-figs. 1–4.
THORPE, L. (MRS. HUNTER). 1928. Alcyonaria of the Abrolhos Islands, Western Australia. J. Linn. Soc. Lond. Zool. XXXVI, pp. 479–531, pls. xxx–xxxiv.
VERRILL, A. E. 1869. Critical Remarks on Halcyonoid Polyps. Amer. J. Sci., ser. ii, XLVII, pp. 282–285.
—— 1928. Hawaiian Shallow Water Anthozoa. Bull. B.P. Bishop Museum, XLIX, pp. 1–30, pls. i–v.
WRIGHT, E. P. and STUDER, TH. 1889. Alcyonaria. "Challenger" Reports—Zool. XXXI, pp. lxxii, 314, 49 pls., text illust.
YONGE, C. M. 1931. A Year on the Great Barrier Reef. London, pp. xx + 246, 69 pls., 17 text-figs., 6 maps.

APPENDIX.

After this report was written, Sir Arthur Thomson very kindly let me see the proof of the Monograph he is publishing, with the co-operation of Miss I. Dean, on "Some of the Alcyonaria Collected by the 'Siboga' Expedition."

They record the occurrence of the following species of Xeniidae in the waters of the Malay Archipelago: *Xenia crassa, X. florida, X. fusca, X. gareiae, X. membranaeea, X. novae-britanniae, X. ternatana, X. umbellata, X. viridis*, and two species which, in my opinion, should be referred to the genus *Heteroxenia*, namely *H. ashworthi* and *H. capensis*. They also describe a new species of *Cespitularia*, as well as specimens of *C. coerulea* and *C. taeniata*. They record the occurrence of *Sympodium coeruleum* in this region, and the following species attributed to the genus *Anthelia*; *A. gareiae, A. glauca, A. ternatana* and a new species.

INDEX

(Page references to the descriptions of genera and species are in heavy type.)

DESCRIPTION OF PLATE I.

All the photographs taken in spirit by Messrs. Hills & Saunders, Cambridge.

Fig. 1.—*Heteroxenia elisabethae*, Kölliker. View of a section through the whole colony showing the long autozooids with tentacles fully expanded and the shorter siphonozooids. The gonads are seen in the cavities of the autozooids.

Fig. 2.—*Cespitularia wisharti*, n. sp. A part of the colony of the type-specimen. This photograph shows polyps arising from the stalk as well as from the capitulum, the characteristic feature of the genus.

Fig. 3.—*Cespitularia mantoni*, n. sp. Seen from above, showing the lobate character of the branches and many of the polyps retracted.

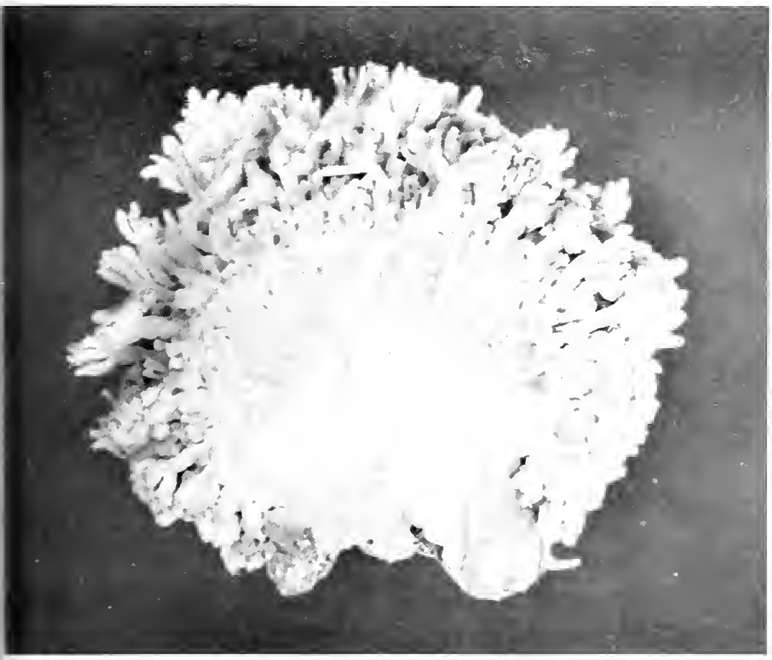


Fig. 1.

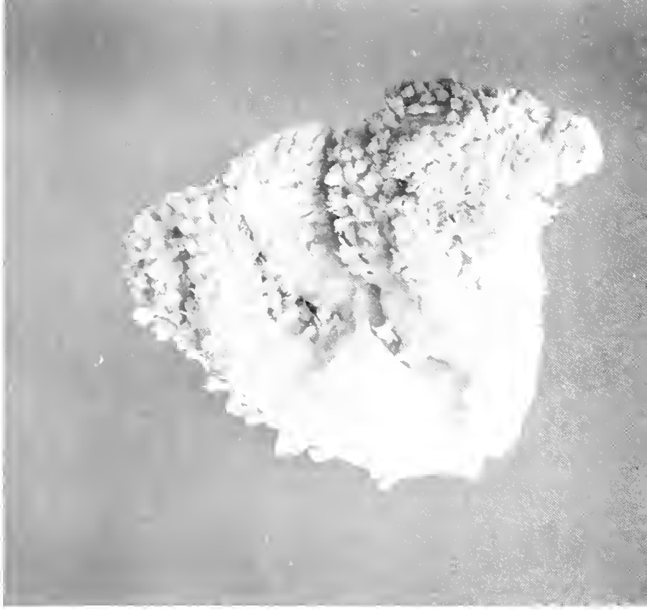


Fig. 2.

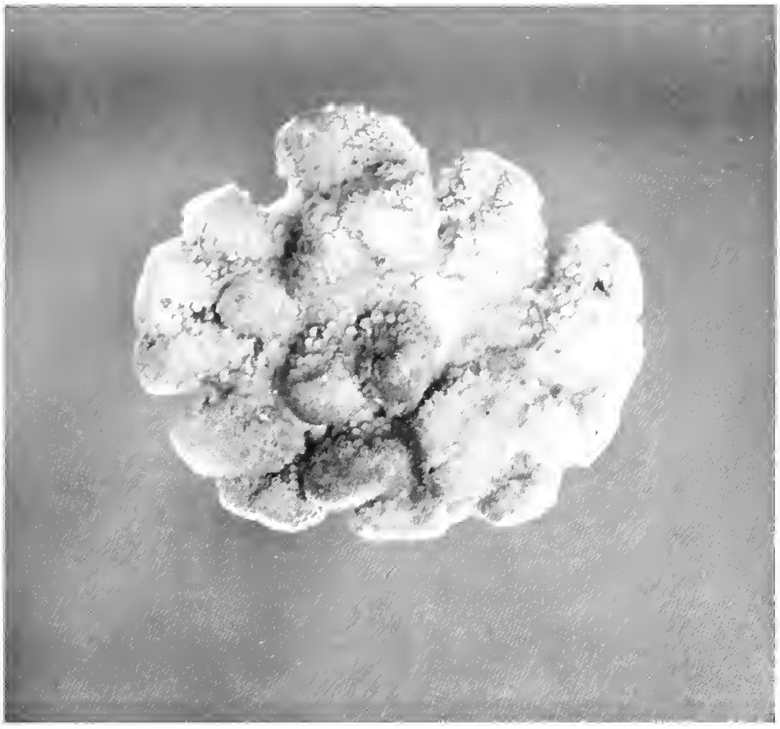


Fig. 3.

[Adlard & Son, I

DESCRIPTION OF PLATE II.

All the photographs taken in spirit by Messrs. Hills & Saunders, Cambridge.

FIG. 4.—*Xenia crassa*, Schenk. Specimen R described on p. 161. × $1\frac{1}{2}$ diams.

FIG. 5.—*Xenia plicata*, Schenk. Specimen from Batt Reef described on p. 158. Nat. size. Note that the polyps and tentacles are longer than in *X. crassa*.

FIG. 6.—*Cespitularia multipinnata*, Quoy & Gaimard. A part of the colony of specimen ω from Three Isles.

FIG. 7.—*Cespitularia wisharti*, n. sp. The young specimen from an unknown locality described on p. 166.

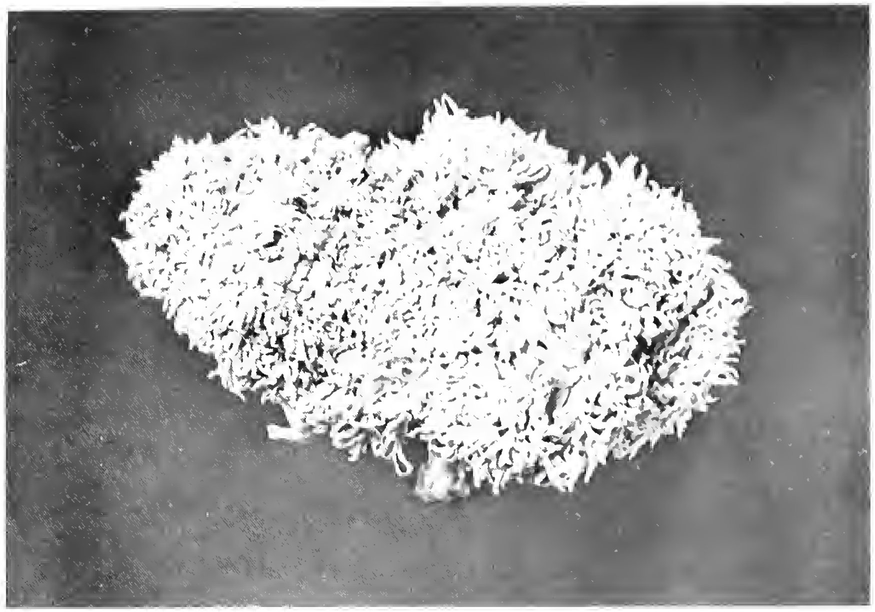


Fig. 4.

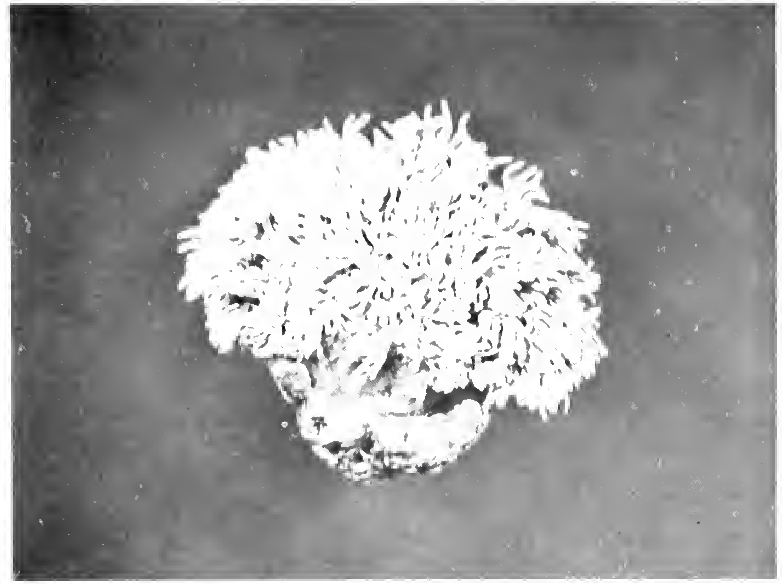
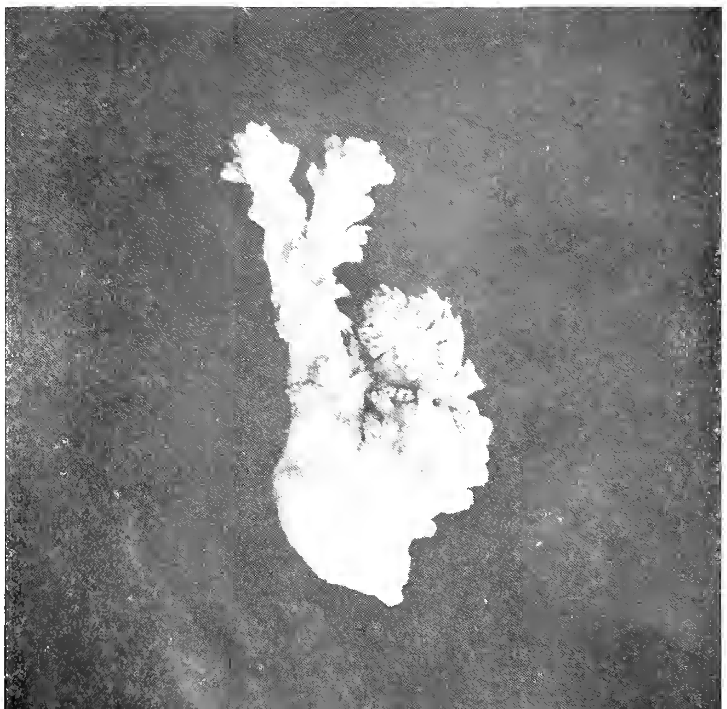
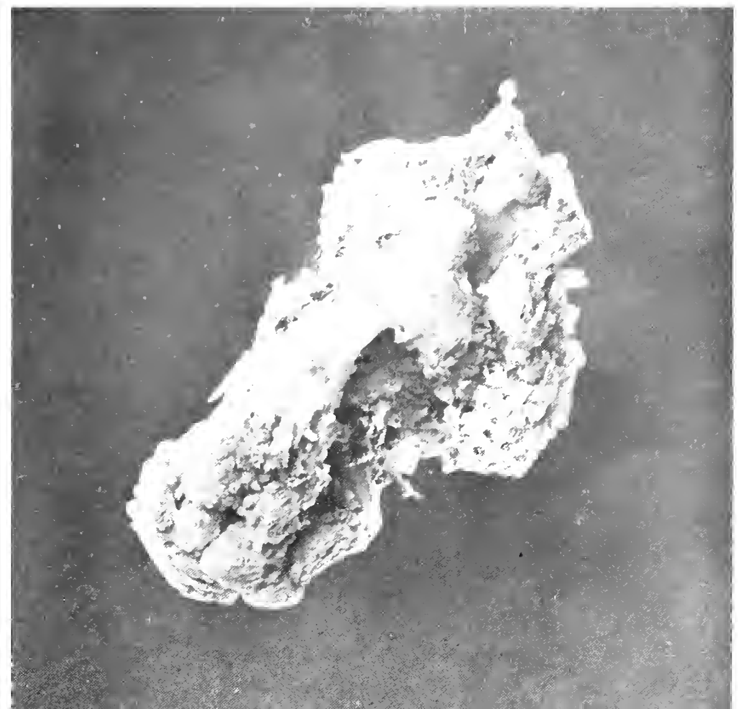


Fig. 5.





BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 6

HYDROIDA

BY

E. A. BRIGGS, D.Sc., AND VALERIE E. GARDNER, B.Sc.

(From the Department of Zoology, University of Sydney)

WITH SIX TEXT-FIGURES AND ONE PLATE

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & Co., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1931

Price One Shilling and Sixpence.

[*Issued 24th October*, 1931]

ADLARD & SON, LTD.
21, HART STREET, W.C.

Made and printed in Great Britain.

HYDROIDA

BY

E. A. BRIGGS, D.Sc., and VALERIE E. GARDNER, B.Sc.

(From the Department of Zoology, University of Sydney.)

WITH SIX TEXT-FIGURES AND ONE PLATE.

INTRODUCTION.

Our knowledge of the Hydroid Fauna occurring in the warm, shallow waters of Eastern Queensland is based mainly on the works of Bale, supplemented by the reports of Busk, Allman and Kirkpatrick. These authors have described and recorded many species from the islands and bays within the protection of the Great Barrier Reef, which extends from the neighbourhood of Torres Strait along the north-east coast of Australia for a distance of 1250 miles.

Collections of Hydroids from the Great Barrier Reef, however, have been surprisingly few, owing, no doubt, to the difficulties encountered during dredging operations among the coral patches that extend over large areas of the ocean floor in this region.

The Hydroids recorded in the following pages from the Great Barrier Reef represent a small but extremely interesting collection of thirteen species, which were obtained as the result of (1) shore-collecting and diving at Low Isles, (2) collecting on the reefs of the Outer Barrier and at Lizard Island, and (3) a series of dredgings carried out at twenty-seven stations along the Queensland coast. Hydroids were secured in seven of these hauls, which were made at depths varying from 4 to 28 fathoms.

The collection contains five species, which are here recorded for the first time from the tropical waters of Eastern Australia, viz. :

Myrionema amboinense, Pictet.
Endocrypta parasitica (Kirk).
Clytia delicatula (Thornely).
Hebella crateroides, Ritchie.
Hincksella sibogae, Billard.

Of special interest is the occurrence of the parasitic Hydroid, *Endocrypta parasitica* (Kirk), on the inner surface of the branchial siphon of a Tunicate (*Polycarpa procera*), which was dredged at Station XXV, Papuan Passage, at a depth of 20 to 25 fathoms. This remarkable Hydroid has previously been recorded only from Tunicates collected in Wellington Harbour, New Zealand, where it was found in the peripharyngeal groove of *Polycarpa* sp., and the stalked Ascidian *Boltenia pachydermatina*.

The hitherto unknown gonosome of *Plumularia longicornis*, Busk, is described and figured, and the species referred to the genus *Halicornaria*.

LIST OF SPECIES.

ATHECATA.

Family Eudendriidae.

*1. *Myrionema amboinense*, Pictet.

Family Clavidae.

*2. *Endocrypta parasitica* (Kirk).

THECATA.

Family Campanulariidae.

*3. *Clytia delicatula* (Thornely).

Family Lafoeidae.

*4. *Hebella crateroides*, Ritchie.

Family Syntheciidae.

*5. *Hincksella sibogae*, Billard.

Family Sertulariidae.

6. *Dynamena crisioides*, Lamouroux.
7. *Idiella pristis* (Lamouroux).

Family Plumulariidae.

8. *Polyplumaria cornuta* (Bale).
9. *Thecocarpus angulosus* (Lamarck).
10. *Lytocarpus philippinus* (Kirchenpauer).
11. *Lytocarpus phoeniceus* (Busk).
12. *Halicornaria longicornis* (Busk).
13. *Aglaophenia cupressina*, Lamouroux.

LIST OF STATIONS.

The following is a list of the localities at which Hydroids were collected by the Expedition :

LOW ISLES.

Myrionema amboinense, Pictet.
Clytia delicatula (Thornely).
Dynamena crisioides, Lamouroux.
Lytocarpus philippinus (Kirchenpauer).

LOW ISLES.
Diving Station, No. 1.

Hebella crateroides, Ritchie.
Lytocarpus phoeniceus (Busk).

Outer Barrier ; Ribbon Reef.

Aglaophenia cupressina, Lamouroux.

Outer Barrier ; June Reef.

Aglaophenia cupressina, Lamouroux.

Lizard Island ; Reef A.

Aglaophenia cupressina, Lamouroux.

* Indicates that the species is here recorded for the first time from the Great Barrier Reef.

CAPE KIMBERLEY, 4 fathoms ; 2nd December, 1928.

Polyplumaria cornuta (Bale).

STATION II.

Linden Bank, 28 fathoms ; bottom, shell and sand ; 24th November, 1928.

Hincksella sibogae, Billard.
Idiella pristis (Lamouroux).
Polyplumaria cornuta (Bale).
Thecocarpus angulosus (Lamarck).

STATION IX.

Penguin Channel, 12 to 14 fathoms ; 22nd February, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).
Halicornaria longicornis (Busk).

STATION XII.

Penguin Channel, 10 to $15\frac{1}{2}$ fathoms ; bottom, rock and shell gravel ; 24th February, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).
Halicornaria longicornis (Busk).

STATION XIII.

Half a mile west of Two Isles, $16\frac{1}{2}$ fathoms ; 7th March, 1929.

Idiella pristis (Lamouroux).
Thecocarpus angulosus (Lamarck).

STATION XXII.

East of Snake Reef, $13\frac{1}{2}$ fathoms ; bottom, mud with Foraminifera and shells ; 11th March, 1929.

Thecocarpus angulosus (Lamarck).

STATION XXV.

In Papuan Pass, 20 to 25 fathoms ; bottom, Foraminifera and coral fragments ; 17th March, 1929.

Endocrypta parasitica (Kirk).
Thecocarpus angulosus (Lamarck).

ATHECATA.

Family Eudendriidæ.

Genus *Myrionema*, Pictet.

Trophosome.—Hydrocaulus well developed, monosiphonic, irregularly branched, surrounded by perisarc. Hydranths long, slender and vase-shaped; hypostome short and slender, distinctly trumpet-shaped; tentacles filiform, very numerous, arising from the base of the hypostome, and arranged in two or three closely appressed rows.

Gonosome.—Female gonophores of the streptospadiceous type, with the spadix almost completely encircling the ovum; borne on the hydranth in verticils of, typically, from four to six.* Male gonophores chambered, club-shaped, typically two to a hydranth on opposite sides.

Genotype.—*Myrionema amboinense*, Pictet.†

Myrionema amboinense, Pictet. (Plate I, figs. 1–3.)

Myrionema amboinensis, Pictet, Rev. Suisse Zool. I, 1893, p. 19, pl. i, figs. 12, 13; pp. 62–64, pl. iii, figs. 55, 56; *idem*, Svedelius, Svensk. Bot. Tidskr. I, 1907, pp. 32–50, figs. 1–6; *idem*, Stechow, Arch. Naturgesch. LXXXVIII, Abt. A, Heft 3, 1922, p. 145; *idem*, Stechow, Zool. Jahrb. Syst. XLVII, 1923, p. 79.

Eudendrium griffini, Light, Philipp. J. Sci. D, VIII, 1913, pp. 333–356, pls. i and ii; *idem*, Hargitt, Philipp. J. Sci. XXIV, 1924, p. 475.

Many colonies of this extremely interesting Hydroid, which was originally described by Pictet from the Island of Amboina, were collected at Low Isles, where the species forms a very characteristic feature of the flat-life of the lagoon. Our material was gathered in large quantities at low tide, attached to dead coral fragments, to marine grasses and calcareous sea-weeds, and to the roots of mangrove trees.

Pictet's specimens were sterile, and the gonophores remained unknown until 1913, when Light published his description of *Eudendrium griffini* from Bantayan Island in the Philippines. Light's species is identical with *Myrionema amboinense*, Pictet; consequently we have arranged the synonymy as above, retaining *Myrionema* as the generic name, but placing it in the Family Eudendriidæ, instead of the Family Myrionemidæ, which Pictet erected for the accommodation of his new genus and species, *M. amboinense.*

Light's description and figures add many interesting details to Pictet's account, which was based on very scanty material from Batou-Mera, Bay of Amboina.

The specimens collected at Low Isles agree in all respects with the characters of the trophosome and of the gonophores as set out by Light; the dimensions are in complete accord with those given for *E. griffini*; but the account of the process by which the deposition of the ova on the pedicels takes place is not corroborated by the stages present in our specimens. Dr. E. A. Fraser, however, has studied this problem with the aid of living specimens, and her observations and conclusions will form the subject of a separate contribution to our knowledge of the Hydroids from the Great Barrier Reef (see Vol. III, No. 4).

* Dr. Fraser, in her report on *Myrionema* in Vol. III of this series, figures up to ten.

† Not *amboinensis*: *Myrionema* is neuter gender.

Trophosome.—The details of the trophosome have been worked out by Light, who recognized the differences between the male and female hydranths. The male hydranths (Plate I, fig. 1) are long, slender and vase-shaped: the sexually immature or sterile female hydranths are similar in appearance to those in the male; the fertile female hydranths (Plate I, fig. 2) are shortened and thickened, and often atrophied.

The arrangement of the tentacles in two or three closely appressed rows immediately distinguishes this form from the members of the genus *Eudendrium*. The hypostome is trumpet-shaped, and is usually hidden by the long tentacles, which arise from around its base, and extend directly forwards in a dense fringe.

Gonosome.—Pictet did not observe the gonophores, but these have been fully described by Light. Both male and female gonophores, as well as eggs attached to the pedicels, have been found on the specimens from Low Isles.

The female gonophores are of the streptospadiceous type with the spadix almost completely encircling the ovum, but with the proximal end not recurved or bifurcated; they are borne on the proximal region of the hydranth in verticils of, typically, from four to six.

The male gonophores are chambered, club-shaped structures of rather irregular outline; they are occasionally bifurcated distally in a vertical plane. There are typically two to a hydranth on opposite sides, slightly below the bases of the tentacles.

Eggs (Plate I, fig. 3) were also observed attached firmly to the perisarc of the pedicels.

Zooxanthellae.—Great numbers of symbiotic algae (Zooxanthellae) occur throughout the endoderm cells of the coenosarc, gastric cavity, tentacles and gonophores. They are extremely numerous in the endoderm cells of the tentacles, where they form a closely packed layer just within the peripheral walls. Pictet has evidently mistaken these algae for the endoderm cells in the tentacles of *M. amboinense*; his drawing (plate iii, fig. 56) of a transverse section through a tentacle clearly shows the zooxanthellae, but he failed to detect the walls of the endoderm cells, and consequently believed that the structure of the tentacles was unique among the Hydroids. Light was unable to identify any of the spherical bodies of the ectoderm cells as Zooxanthellae, but a few scattered examples of these symbiotic algae were observed in the ectoderm cells from the coenosarc of our Low Isles specimens.

Synonomy.—Light's *Eudendrium griffini* from Bantayan Island, Philippines, is identical with *Myrionema amboinense*; therefore we have arranged the synonymy as above. Hargitt has also recorded this Hydroid from the Philippine Islands under the name of *E. griffini*.

Systematic Position.—Pictet erected the Family Myrionemidae to accommodate his new genus and species, *Myrionema amboinense*. We prefer to regard this Hydroid as a primitive member of the Family Eudendriidae, basing this assumption on the characters of the trophosome, as well as on the form of the male and female gonophores. Stechow has expressed the opinion that *M. amboinense* directly connects the Family Eudendriidae with the Clavidae and not with the Bougainvilliidae.

Locality.—Low Isles, Great Barrier Reef. This Hydroid was gathered at low tide in great quantities, attached to dead coral fragments, to marine grasses and calcareous sea-weeds, and to the roots of mangrove trees growing in the lagoon.

Distribution.—Previously recorded from Batou-Mera, Bay of Amboina (Pictet); Ceylon (Svedelius); Bantayan Island, Philippines (Light); Philippine Islands (Hargitt). This species is new to the Great Barrier Reef.

Family Clavidae.

Genus *Endocrypta*, Fraser.

Crypta, Fraser, Bull. Labs. Nat. Hist. Univ. Iowa, VI, i, 1911, p. 19.
Endocrypta, Fraser, Trans. Roy. Soc. Canada (3), VIII (Sect. 4), 1914, p. 109.
Ascidioclava, Kirk, Trans. N. Z. Inst. XLVII, 1914 (1915), p. 146.

Genotype.—*Endocrypta huntsmani*, Fraser.

Endocrypta parasitica (Kirk).

Ascidioclava parasitica, Kirk, Trans. N. Z. Inst. XLVII, 1914 (1915), p. 146.

Specimens of this very remarkable parasitic Hydroid occur on the inner surface of the branchial siphon of a Tunicate, *Polycarpa procera* (Sluiter). The characters present in both the trophosome and gonosome are in extraordinarily close agreement with those given for *Ascidioclava parasitica*, which Kirk found in association with Ascidians collected in Wellington Harbour, New Zealand. According to Kirk's account, this Hydroid occurs in the peripharyngeal groove of a species of *Polycarpa*, as well as in the stalked form *Boltenia pachydermatina*.

Fraser has also described, under the name of *Endocrypta huntsmani*, a rather remarkable species found only in the branchial cavity of simple Ascidians dredged in from 5 to 20 fathoms in Departure Bay, Vancouver Island, British Columbia. These Hydroids were not confined to individuals of the same species, since specimens have been discovered in members of the genera *Phallusia*, *Ascidiopsis*, *Ciona* and *Tethyum*.

A comparison of the Barrier Reef specimens with a slide of Fraser's material in the Australian Museum Collection reveals the generic identity of *Ascidioclava* with *Endocrypta*, and since the latter genus has priority, we arrange the synonymy as above, changing the name of Kirk's species to that of *Endocrypta parasitica*.

There is also to be noted a very striking resemblance between the specific characters of these two Hydroids, but in view of the slight differences, which appear to be constant, we prefer to retain *E. parasitica* as a distinct, though closely-related species.

Trophosome.—The hydrocaulus and hydranth together reach a height of nearly 3 mm. In this respect *E. parasitica* differs considerably from *E. huntsmani*, which is a much larger and more robust species, attaining a height of 8 mm.

The hydranth is distinctly club-shaped, with its proximal end narrowing rather abruptly at its junction with the hydrocaulus. In *E. huntsmani* the hydranth passes almost imperceptibly into the hydrocaulus, whose diameter is very slightly less than the greatest width of the hydranth.

The shape of the manubrium varies considerably in the preserved specimens, but the mouth never becomes reflexed entirely, so that it is folded back over the bases of the tentacles, these also being turned backward to point towards the base, as sometimes happens in *E. huntsmani*.

In Kirk's New Zealand specimens the hydrocaulus remained unbranched. We have observed in a single instance a branched hydrocaulus, but the division had taken place just above the hydrorhiza, resulting in the formation of two well-developed hydrocauli. Fraser has described a forked condition, in which the division occurred directly below the bases of the hydranths, so that " the two parts seem to be of equal significance, and seldom differ much in size."

In both species the tentacles have a jointed appearance, due to the arrangement of the nematocysts, which occur in large numbers throughout the ectoderm.

Gonosome.—The specimens bear developing medusa-buds, either singly or in groups of two, near the base of the hydranth. The most advanced stage is provided with four very short, blunt tentacles. This bud is distinctly campanulate, with a very short stalk. The manubrium is pear-shaped.

Synonomy.—Trebilcock* identifies *Ascidioclava parasitica*, Kirk, with *Endocrypta huntsmani*, Fraser. Whilst regarding these Hydroids as congeneric, we have retained Kirk's species and changed the name to *Endocrypta parasitica*.

Locality.—Station XXV, in Papuan Passage, 20 to 25 fathoms ; bottom, Foraminifera and coral fragments, 17th March, 1929.

Distribution.—Previously recorded only from Wellington Harbour, New Zealand. This species is new to the Great Barrier Reef.

THECATA.

Family Campanulariidae.

Genus *Clytia*, Lamouroux.

Clytia delicatula (Thornely).

Clytia sp., Inaba, Zool. Mag. Tokio, 1890, figs. 34, 35.
Obelia delicatula, Thornely, Willey Zool. Res. IV, 1900, p. 453, pl. xliv, fig. 7.
Campanularia delicatula, Jäderholm, Bih. Svensk. Vetensk. Akad. Handl. XXVIII, Afd. 4, No. 13, 1902, p. 3.
Clytia delicatula, Stechow, Abh. Bayer. Akad. Wiss. III Suppl.-Bd., 2 Abh., 1913, p. 65, figs. 20, 21 ; *idem*, Stechow, Zool. Jährb., Syst. XLVII, 1923, p. 109.

It is with some hesitation that we refer this frail species of *Clytia* to Thornely's *Obelia delicatula*, which was originally collected by Willey in Blanche Bay, New Britain, at a depth of forty fathoms. Thornely's exceedingly brief description omits all reference to the salient features of the gonosome, although gonangia were present with recognizable medusae.

Stechow has identified *Obelia delicatula* Thornely with Inaba's *Clytia* sp. from " Boneri," Bishamon Cove, Sagami Sea. Fortunately Stechow has republished Inaba's excellent description and text-figures, which furnish many details overlooked by Thornely, and enable us to refer the Low Isles specimens with some degree of certainty to *Clytia delicatula* (Thornely). Jäderholm has also recorded this species, under the name of *Campanularia delicatula*, from Japanese waters.

In the specimens before us the characters of the trophosome agree with Inaba's description and figures reproduced by Stechow. The form of the gonangia, however, is not in exact agreement with Inaba's drawings, since the peduncle is somewhat more pronounced in the Low Isles specimens than in those from Japan.

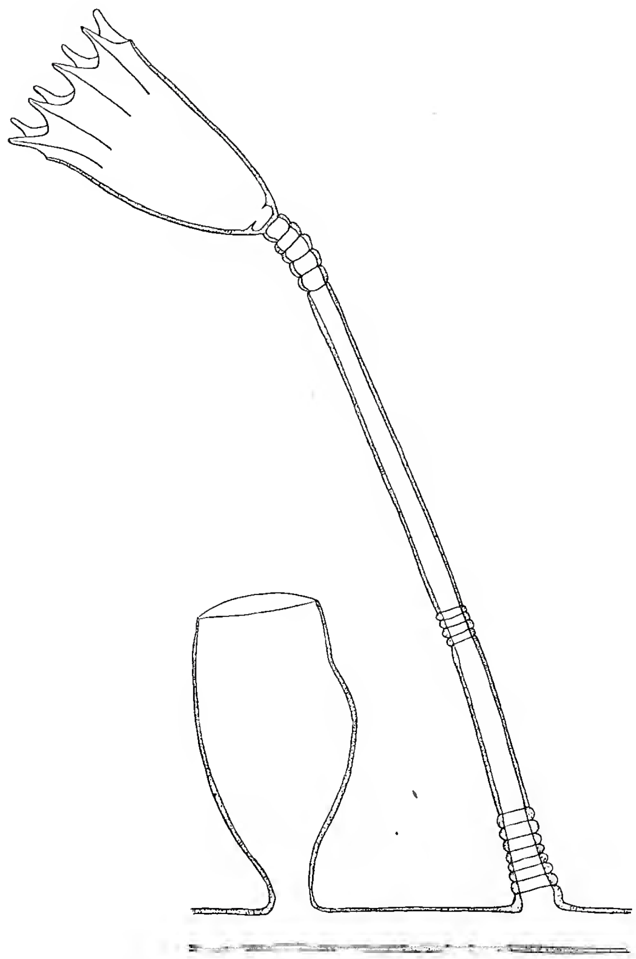
The gonangia arise from the creeping stolon, but in a single instance a gonangium was observed to spring from one of the long peduncles bearing a hydrotheca. Stages in

* Trebilcock, Proc. Roy. Soc. Vict., n.s., XLI, 1928, p. 1.

the development of the medusae can be seen in the various gonangia, but the material does not permit of a detailed description of the characters assumed by the fully-formed medusa.

DIMENSIONS.—

Stolon, diameter	0·07–0·09 mm.
Peduncle of hydrotheca, length	Up to 1·8 ,,
,, ,, diameter	0·06–0·07 ,,
Hydrotheca, length	0·49–0·62 ,,
,, diameter at mouth	0·17–0·32 ,,
Gonangium, length	0·64–0·81 ,,
,, greatest diameter	0·24–0·29 ,,



TEXT-FIG. 1.—*Clytia delicatula* (Thornely).

LOCALITY.—Low Isles, Great Barrier Reef. Numerous colonies were found, growing on Sargassum weed collected in the lagoon and along the sandy beach January, 1929.

DISTRIBUTION.—Previously recorded from "Boneri," Bishamon Cove, Sagami Sea (Inaba); Blanche Bay, New Britain, 40 fathoms (Thornely); Hirudo Strait, Japan (Jäderholm); Sagami Bay, Japan (Stechow); Golden Hind near Niigata, west coast of Hondo, Japan (Stechow). The species is new to the Great Barrier Reef.

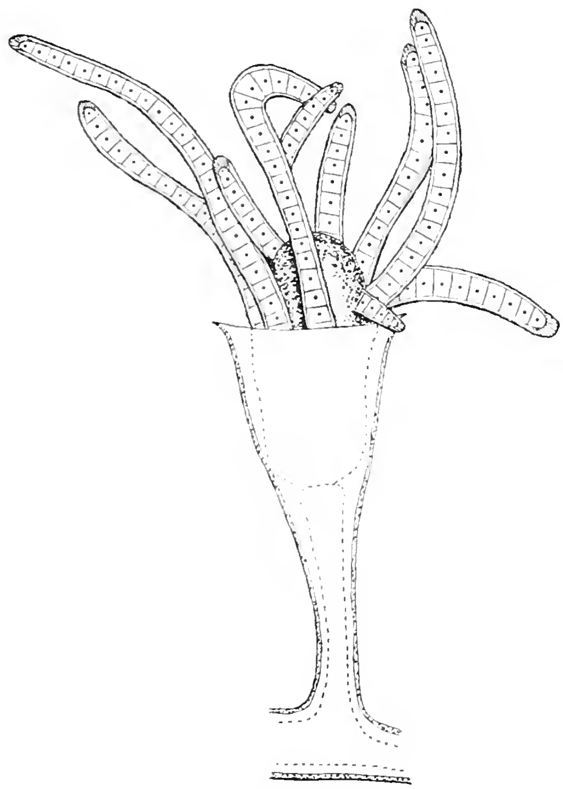
Family Lafoeidae.

Genus *Hebella*, Allman.

Hebella crateroides, Ritchie.

Hebella crateroides, Ritchie, Rec. Ind. Mus. V, 1910, p. 6, pl. iv, fig. 1; *idem*, Jarvis, Trans. Linn. Soc. Lond. Zool. XVIII, 1922, p. 336.

A single colony occurs on the stem and branches of a Plumularian Hydroid (*Lytocarpus phoeniceus*) from Diving Station No. 1, Low Isles. From a creeping hydrorhiza there arise here and there small colourless hydrothecae with gracefully everted margins. These



Text-fig. 2.—*Hebella crateroides* (Ritchie).

hydrothecae are somewhat larger than those originally described from the Andaman Islands. The hydranths bear from ten to eleven tentacles, whereas Ritchie's specimens had about six to eight tentacles.

Gonosome absent.

Dimensions.—		Barrier Reef specimens.	Andaman Islands specimens.
Hydrotheca,	length . .	0·42–0·45 mm. .	0·36–0·39 mm.
,,	diameter at mouth	0·18–0·20 ,, .	0·18–0·21 ,,

Locality.—Growing on *Lytocarpus phoeniceus* from Diving Station No. 1, Low Isles, Great Barrier Reef.

Distribution.—Previously recorded from Andaman Islands, 270 to 45 fathoms (Ritchie); Farquhar Atoll (Jarvis). This species is new to the Great Barrier Reef.

Family Synthecidae.

Genus *Hincksella*, Billard.

Hincksella, Billard, Arch. Zool. Exp. Gén., Notes et Revue, LVII, 1918, p. 22; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, 2, Synthecidae et Sertularidae, 1925, p. 121.

Hincksella sibogae, Billard.

Hincksella sibogae, Billard, Arch. Zool. Exp. Gén., Notes et Revue, LVII, 1918, p. 23, fig. 2; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, 2, Synthecidae et Sertularidae, 1925, pl. 122, p. vii, fig. 1, and text-fig. 1*a–e*.

A solitary colony, 57 mm. in height, alone represents this species from Station II. The main stem, which is fascicled at the base, is denuded of its branches for a length of 38 mm.; the distal 19 mm. bear nine alternate branches. The characters of the trophosome are in complete agreement with those described by Billard. The shape of the hydrothecae is very characteristic; each has a regular circular margin, without a trace of operculum. The hydrotheca attains its greatest diameter at the mouth, and gradually narrows towards the base. The adcauline wall is adnate for the greater part of its length, the free moiety consequently being very short.

Gonosome absent.

Dimensions.—		Barrier Reef specimen.	Siboga specimen.
Hydrotheca,	length . . .	0·24–0·26 mm.	0·21–0·24 mm.
,,	diameter at mouth	0·29–0·31 ,,	0·26–0·28 ,,

Locality.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928.

Distribution.—Hitherto recorded only from "Siboga" Station 49a in 8° 23·5′ S., 119° 4·6′ E.; Détroit de Sapeh, 69 m.; "Siboga" Station 65a, Très près de la Station 65, dont la latitude et la longitude sont 7° 0′ S., 120° 34·5′ E., 3–400 m. (Billard). This species is new to the Great Barrier Reef.

Family Sertulariidae.

Genus *Dynaemna*, Lamouroux.

Dynamena crisioides, Lamouroux.

Dynamena crisioides, Lamouroux, Des. Polyp. Flex., in Quoy et Gaimard, Voyage . . . l'Uranie et la Physicienne Zool. 1824, p. 613, pl. 90, figs. 11, 12; *idem*, Billard, Les Hydroides de l'Exped. du Siboga, VII*b*, Synthecidae et Sertularidae, 1925, p. 181, pl. vii, fig. 21, text-figs. xxxvi–xxxvii.
Dynamena tubuliformis, Marktanner-Turneretscher, Ann. Naturh. (Mus.) Hofmus. Wien, V, 1890, p. 238, pl. iv, fig. 10.
Thuiaria tubuliformis, Briggs, Rec. Aust. Mus. XII, 1918, p. 38 (references).

Many specimens of this typical, tropical species, the largest 22 mm. in height, were collected at Low Isles, where it proved to be the most frequently-occurring Hydroid on the reef. The colonies were usually found attached to the sides and bases of dead coral blocks left exposed, often for considerable periods, at low tide.

Gonosome.—Gonangia of characteristic form were present on many of the colonies collected during the month of January, 1929.

Synonomy.—We have assigned these specimens to *Dynamena crisioides*, following Billard, whose examination of Lamouroux's type has established the identity of Marktanner-Turneretscher's *D. tubuliformis* with *D. crisioides*.

Locality.—Low Isles, Great Barrier Reef.

Genus *Idiella*. Stechow.

Idia, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 199 (name preoccupied).
Idiella, Stechow, Zool. Jährb., Syst. Bd. XLII, 1919, p. 106.

Idiella pristis (Lamouroux).

Idia pristis, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 200, pl. v, figs. AA, B, C, D, E; *idem*, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 113, pl. vii, figs. 1, 2; pl. xix, fig. 33.
Diphasia rectangularis, Lendenfield, Proc. Linn. Soc. N.S. Wales, IX, 1885, p. 914, pl. xli, figs. 6–8.

The colonies of this widely-distributed species agree in detail with Bale's description and figures of other Australian specimens, except that the slight angular ridge extending along the front of the hydrotheca, from the base to the aperture, is generally absent.

Localities.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928. Station IX, Penguin Channel, 12 to 14 fathoms; 22nd February, 1929. Station XII, Penguin Channel, 10 to 15½ fathoms; bottom, rock and shell; 24th February, 1929. Station XIII, half a mile west of Two Isles, 16½ fathoms; 9th March, 1929.

Family Plumulariidae.

Genus *Polyplumaria*, Sars.

Polyplumaria cornuta (Bale).

Plumularia cornuta, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 132, pl. xi, figs. 1, 2.
Polyplumaria cornuta, Billard, Les Hydroides de l'Exped. du Siboga, VII*a*, I, Plumulariidæ, 1913, p. 53, pl. iii, fig. 33; pl. iv, figs. 35, 36.

Two specimens, the larger reaching a length of 45 cm., represent this rather variable species originally described by Bale from an incomplete colony two feet in height. The characters of the trophosome are similar to those enumerated in Billard's extended description, which supplements Bale's account of the distribution of the sarcothecae and the structure of the aborted secondary hydrocladia.

Dimensions.—

Hydrocladium, length	Up to 8 mm.
Hydroclade internode, length	0·34–0·37 ,,
Secondary hydrocladium, length	0·49–0·60 ,,
Hydrotheca, depth	0·17 ,,
,, breadth at mouth	0·10–0·12 ,,

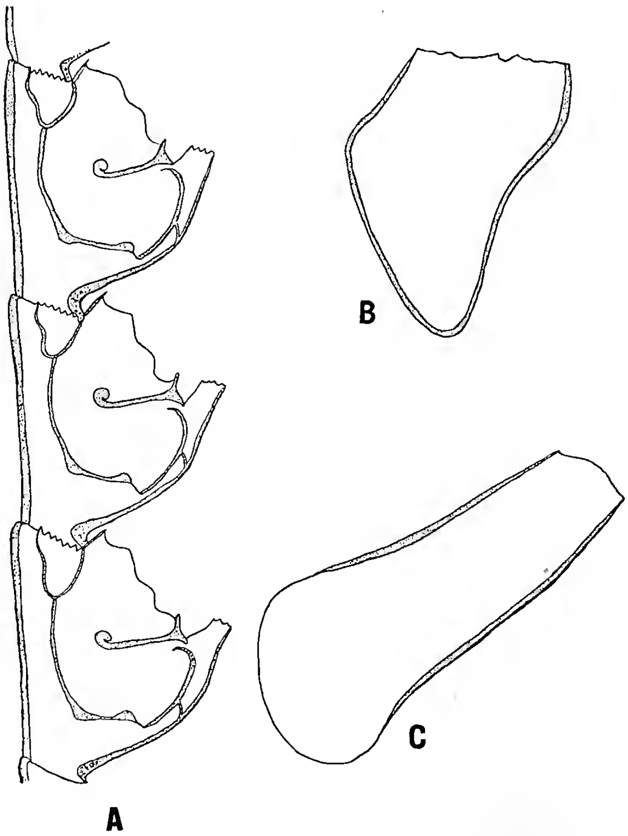
Localities.—Station II, Linden Bank, 28 fathoms; bottom, shell and sand; 24th November, 1928. Quarter of a mile south of Cape Kimberley, 4 fathoms; 2nd December, 1928.

Distribution.—Previously recorded from Port Molle, 15 fathoms; Port Denison; and Holborn Island, 20 fathoms, Queensland (Bale). The "Siboga" Expedition secured numerous specimens of this species at sixteen stations in the East Indies, at depths ranging from 9 to 216 metres (Billard).

Genus *Thecocarpus*, Nutting.

Thecocarpus angulosus (Lamarck).

Plumularia angulosa, Lamarck, Hist. Nat. des Anim. sans Vert. II, 1816, p. 126.
Thecocarpus angulosus, Billard, Les Hydroides de l'Exped. du Siboga, VII*a*, I, Plumulariidæ, 1913, p. 85, figs. lxx–lxxiv (synonymy).
Acanthocladium angulosum, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 476.



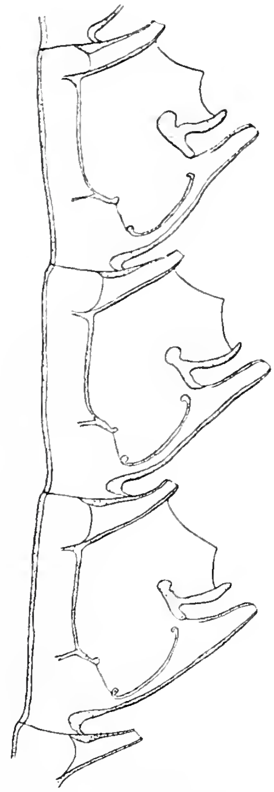
Text-fig. 3.—*Thecocarpus angulosus* (Lamarck). a. Hydrothecae. b. Lateral sarcotheca from a hydrotheca situated near the distal extremity of a hydrocladium. c. Lateral sarcotheca from a hydrotheca situated near the proximal end of a hydrocladium.

Numerous colonies of this exceedingly variable species were obtained in the dredge at six different stations, at depths ranging from 10 to 28 fathoms. The form of the hydrothecae approaches closest to the drawing (fig. lxx, c) given by Billard in his "Siboga" Report for a specimen from Station 164. In the specimens before us, a small septum runs across the cavity of the mesial sarcotheca. This structure is apparently wanting in the "Siboga" specimens, although Billard's figures indicate a thickening of the perisarc at the point where this partition occurs in the Barrier Reef forms of *T. angulosus*.

The lateral sarcothecae display a very wide range of variation ; those accompanying a hydrotheca situated near the distal extremity of a hydrocladium are short and broad, with a distinctly crenulated margin, but a gradual change in shape takes place, until in the proximal portion of the hydrocladium they have become drawn out into long tubular structures.

GONOSOME.—Corbulae, up to 8 mm. in length, occur on several of the colonies. They are of the open type, consisting of ten to eleven pairs of separate corbula-leaves, and carry a series of gonangia in the form of ovate bodies with extremely short peduncles for attachment.

LOCALITIES.—Station II, Linden Bank, 28 fathoms ; bottom, shell and sand ; 24th November, 1928. Station IX, Penguin Channel, 12 to 14 fathoms ; 22nd February, 1929. Station XII, Penguin Channel, 10 to 15½ fathoms ; bottom, rock and shell ; 24th February, 1929. Station XIII, half a mile west of Two Isles, 16½ fathoms ; 7th March, 1929. Station XXII, east of Snake Reef, 13½ fathoms ; bottom, mud with Foraminifera and shells ; 11th March, 1929. Station XXV, in Papuan Passage, 20 to 25 fathoms ; bottom, Foraminifera and coral fragments ; 17th March, 1929.



TEXT-FIG. 4.—*Lytocarpus philippinus* (Kirchenpauer).

Genus *Lytocarpus*, Allman.

Lytocarpus philippinus (Kirchenpauer).

Aglaophenia philippina, Kirchenpauer, Abh. Natur. Hamburg, V, Abt. 3, 1872, p. 45, pls. i, ii, vii, fig. 26.
Aglaophenia urens, Kirchenpauer, Abh. Natur. Hamburg, V, Abt. 3, 1872, p. 46, pls. i, ii, vii, fig. 27.
Lytocarpus phillipinus, Bale, Proc. Roy. Soc., Vict. XXXI (N.S.), 2, 1919, p. 351 (synonymy).
Macrorhynchia philippina, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 475.

A number of small colonies, the largest not exceeding 28 mm. in height, were collected on the branches of dead corals taken from the Moat, Low Isles. The specimens possess similar trophosome characters to those described by Bale, except that the hydrothecae have distinct lateral lobes with definite embayments between them.

Gonosome absent.

Colour in life, pale blue.

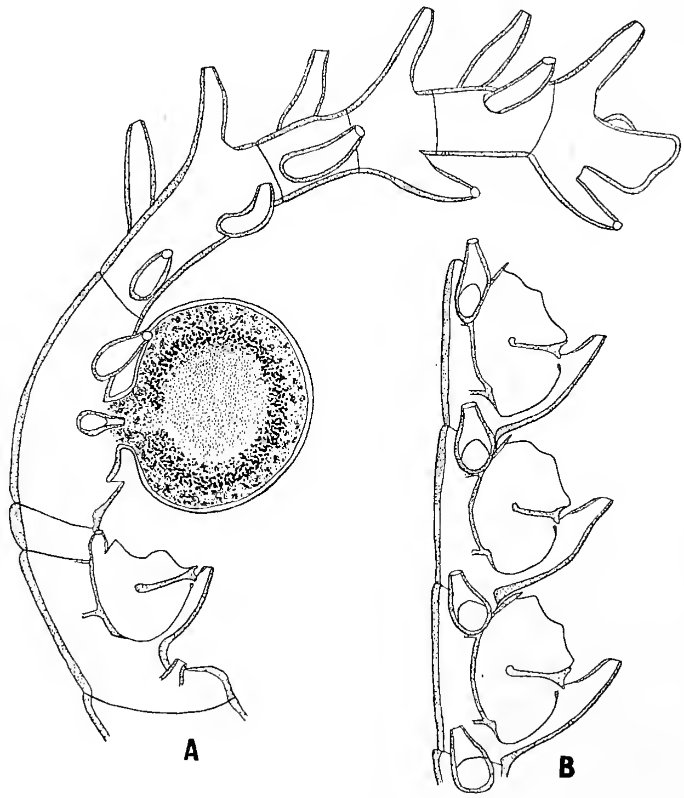
DIMENSIONS.—

Hydrocladium, length	up to 4 mm.
Hydroclade internode, length	0·30–0·33 ,,
Hydrotheca, depth	0·25–0·28 ,,
,, breadth at mouth	0·12–0·14 ,,

LOCALITY.—The Moat, Low Isles, Great Barrier Reef; 19th March, 1929, and 20th May, 1929.

Lytocarpus phoeniceus (Busk).

Plumularia phoenicia, Busk, Voy. of "Rattlesnake," Edited by J. Macgillivray, I, 1852, p. 398.
Aglaophenia phoenicea, Bale, Cat. Austr. Hydr. Zooph. 1884, p. 159, pl. xv, figs. 1–5; pl. xvii, figs. 1–4; pl. xix, fig. 31.



TEXT-FIG. 5.—*Lytocarpus phoeniceus* (Busk). A. Modified hydrocladium bearing lenticular gonangium and two rows of sarcothecae. B. Hydrothecae.

The collection contains several specimens of *Lytocarpus phoeniceus,* which were collected at Diving Station No. 1, Low Isles. The characters of the trophosome most nearly resemble those in Bale's figure (pl. xv, fig. 5) of a variety from Gloucester Passage, Queensland.

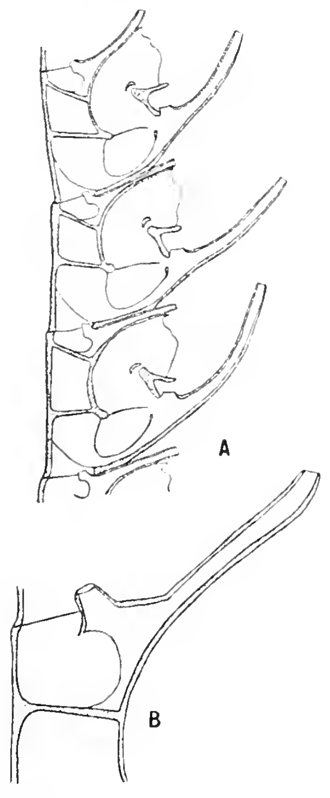
GONOSOME.—The colonies carry typical, lenticular gonangia, each of which is attached to a modified hydrocladium, armed with two rows of long sarcothecae. The proximal internode of the hydrocladium bears a hydrotheca with a very reduced mesial sarcotheca.

LOCALITY.—Diving Station No. 1, Low Isles, Great Barrier Reef; 19th May, 1929.

Genus *Halicornaria*, Busk.

Halicornaria longicornis (Busk). (Plate I, fig. 4.)

Plumularia longicornis, Busk, Voy. "Rattlesnake," Edited by J. Macgillivray, I, 1852, p. 399.
Aglaophenia longicornis, Kirchenpauer, Abh. Ver. Hamb. V. Abt. 3, 1872, p. 47, pls. i and vii, fig. 28; *idem*, Bale, Cat. Austr. Hyd. Zooph. 1884, p. 157, pl. xiv, figs. 7, 8; pl. xvii, fig. 5; *idem*, Marktanner-Turneretscher, Ann. naturh. (Mus.) Hofmus. Wien, V, 1890, p. 267; *idem*, Kirkpatrick, Proc. Roy. Dublin Soc., 1890, p. 604.
Lytocarpus longicornis, Bedot, Rev. Suisse Zool. XXVIII, 1921, pp. 315, 321.
Macrorhynchia (?) *longicornis*, Stechow and Müller, Abh. Senckenb. Naturf. Ges. XXXV, 1923, p. 474.



TEXT-FIG. 6.—*Halicornaria longicornis* (Busk). A. Hydrothecae. B. Lateral sarcotheca.

The colony from Station IX is yellowish-white in colour and reaches a height of 6 cm. The specimens from Station XII are much darker in colour, due to the presence of black or very dark brown pigment-granules in the cells of the coenosarc and in the tissues of the hydranths. The largest colony from this station attains a height of 19 cm., while two other specimens from the same locality measure 13 and 14 cm. in height respectively.

The macroscopic appearance of this Hydroid and the structure of the trophosome have been fully described by Bale and other writers, but the gonangia have always escaped observation, even when fully-grown specimens have been available for examination.

Two of the colonies from Station XII are of extreme interest, since they bear mature gonangia. The presence of these structures enables us to describe and figure the gonosome for the first time.

Gonosome.—The gonangia are carried on the front of the branches between the bases of the hydrocladia. They form a row of fan-shaped receptacles along the branch, each one springing from a mammiliform process, which bears also a hydrocladium and two cauline sarcothecae.

The gonangium, when viewed in its broader aspect, exhibits a very short peduncle arising from a mammiliform process of the branch. Above the point of attachment the walls of the gonangium (Plate I, fig. 4) rapidly diverge, forming a fan-shaped structure, which reaches a breadth of 0·35 to 0·37 mm. The distal extremity of the gonangium is markedly convex. In side view the gonangium appears extremely thin and compressed, with a width of only 0·09 to 0·11 mm.

Dimensions.—

Gonangium, length	0·48–0·53 mm.
,, breadth in frontal aspect	0·35–0·37 ,,
,, ,, lateral aspect	0·09–0·11 ,,

Localities.—Station IX, Penguin Channel, 12 to 14 fathoms ; 22nd February, 1929. Station XII, Penguin Channel, 10 to 15½ fathoms ; bottom, rock and shell ; 24th February, 1929.

Distribution.—Previously recorded from Torres Straits (Busk) ; Singapore (Kirchenpauer) ; Fitzroy Island and Albany Passage, Queensland (Bale) ; Port Jackson, N.S. Wales (Marktanner-Turneretscher) ; Aru Islands (Stechow and Müller).

Genus *Aglaophenia*, Lamouroux.

Aglaophenia cupressina, Lamouroux.

Aglaophenia cupressina, Lamouroux, Hist. Polyp. Cor. Flex. 1816, p. 169 ; *idem*, Bale, Biol. Res. "Endeavour," III, 1915, p. 319, pl. xlvii, figs. 6–8 (synonymy).

Three colonies, the largest attaining a height of 15 cm., represent this characteristic, reef-inhabiting species.

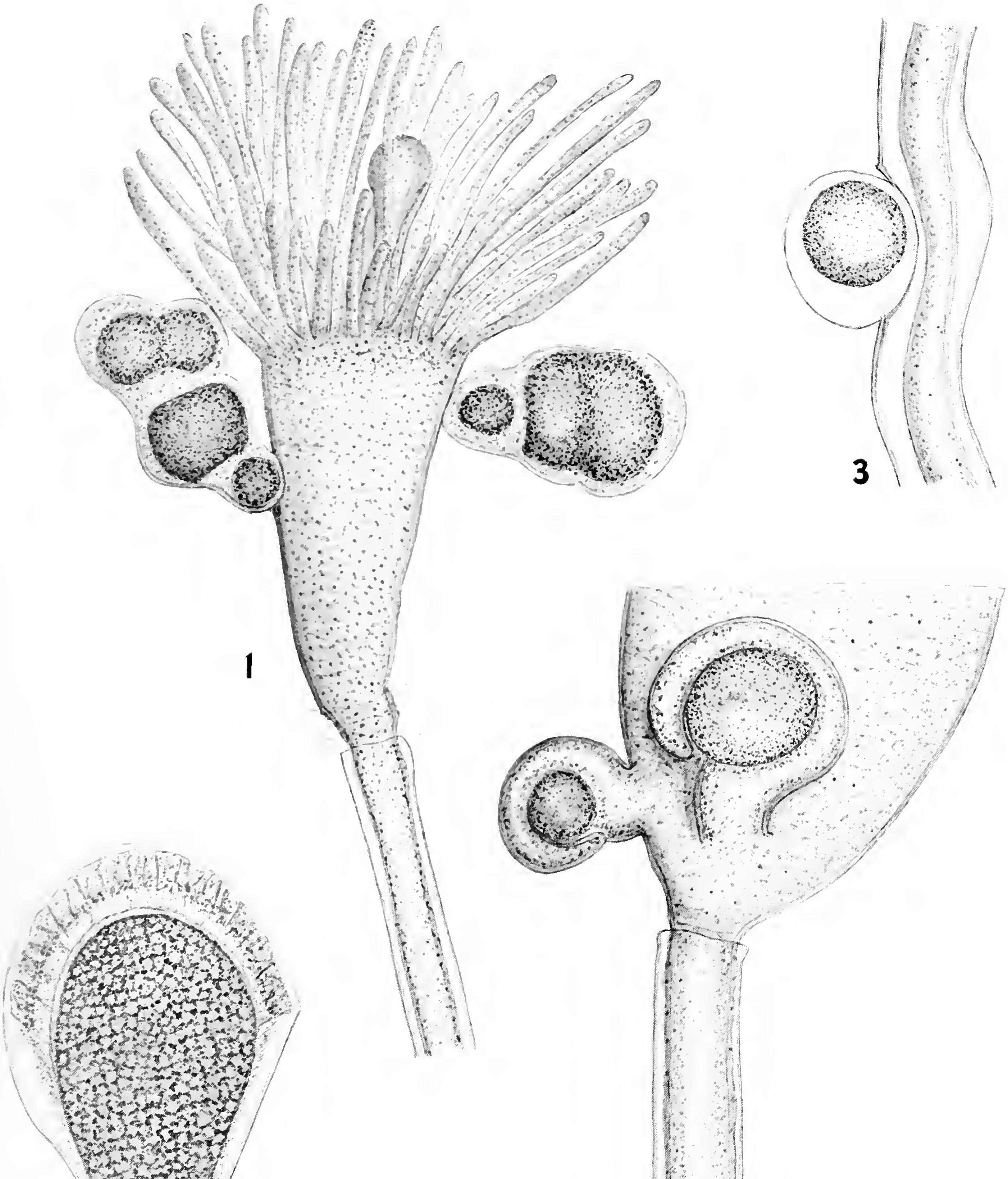
Gonosome.—Immature corbulae are present on the specimens.

Localities.—Lizard Island, Reef A ; 3rd June, 1929. Ribbon Reef, Outer Barrier ; 4th June, 1929. June Reef, Outer Barrier ; 6th June, 1929.

Distribution.—This species has previously been recorded by Bale from the Great Barrier Reef at North-West Island, off Port Curtis, Queensland. Billard's "Siboga" Report discusses the distribution of this species, which has been described under various synonyms from many widely-separated localities in the Indian and Pacific Oceans. More recently Hargitt (Philipp. J. Sci. Manila, XXIV, 1924) has recorded this Hydroid as *Aglaophenia macgillivrayi* (Busk) from the reefs near Mindanao, Philippine Islands, at a depth of 8 to 10 fathoms.

PLATE I.

Fig. 1.—*Myrionema amboinense*, Pictet. Hydranth bearing male gonophores.
Fig. 2.—*Myrionema amboinense*, Pictet. Proximal end of hydranth with female gonophores.
Fig. 3.—*Myrionema amboinense*, Pictet. Egg attached to pedicel.
Fig. 4.—*Halicornaria longicornis* (Busk). Gonangium in frontal aspect.



E. A. Briggs, del.] [Adlard & Son, Ltd., Impr.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 7

ECHINODERMATA
(OTHER THAN ASTEROIDEA)

BY

HUBERT LYMAN CLARK

(Museum of Comparative Zoology, Cambridge, Mass.)

WITH NINE TEXT-FIGURES AND ONE PLATE

LONDON
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1932

Price Two Shillings and Sixpence

[*Issued 27th February*, 1932]

ECHINODERMATA
(OTHER THAN ASTEROIDEA)

BY

HUBERT LYMAN CLARK

(Museum of Comparative Zoölogy, Cambridge, Mass.)

WITH NINE TEXT-FIGURES AND ONE PLATE

CONTENTS

INTRODUCTION.

The collection of echinoderms made by the Great Barrier Reef Expedition seems to be very representative of the area where it was obtained. As sent to me, it lacks the sea-stars, a report on which is being prepared by my friend and colleague, Mr. Arthur A. Livingstone, of the Australian Museum.

The collection examined by me contains more than five hundred specimens, representing 117 species and varieties and 66 genera. While only four species and one variety require description as new, the additions to the Australian fauna and the extensions of geographical range are of very real importance, so that it can fairly be said that the work of the Great Barrier Reef Expedition has added much to our knowledge of Australian echinoderms. Six genera and 14 species are here listed for the first time from that region, while five additional species were not known hitherto from Queensland. But it should be noted that five of the six genera were taken only in the deep-water dredgings at St. XV, 210 fms. Very little such dredging has been done off the Queensland coast, and hence it is not surprising that these hauls should have proved so remunerative. Further analysis of the collection will be found in the introductory paragraph, under each of the four classes.

CRINOIDEA.

The collection of crinoids contains 56 specimens of 18 species, representing 11 genera, all comatulids. None of the species is new to science, but two, *Comatella nigra* and *Iconometra anisa*, have not previously been reported from south of the Murray Islands. Only a dozen species were taken in the Low Isles neighbourhood, the other six coming from the vicinity of Lizard Island. The best collecting would seem to have been in the latter region, where at St. XIV half a dozen species were taken, of which three were not found at Low Isles.

My friend, Mr. Austin Hobart Clark, of the United States National Museum, the recognized authority on crinoids, has been most kind in examining some of the perplexing specimens and giving me the benefit of his wide experience and expert knowledge. It is a pleasure to thank him here for his generous help.

Comatella nigra (Carpenter).

Actinometra nigra, P. H. Carpenter, 1888, Voy. "Challenger," XXVI, pt. 60, Crinoidea, 2, p. 304.
Comatella nigra, A. H. Clark, 1908, Smithson. Misc. Coll. LII, p. 207.

There are five specimens, much alike in size, colour and number of arms, from St. XIV, 19 fms. In life they were "purple, distal ends of arms yellow." In alcohol they are uniformly deep purple, 200–225 mm. in diameter and have about 43 arms; cirri 16–18, with 26–29 segments. The occurrence of *nigra* near Lizard Island extends the known range of the species a little to the south.

Comatula pectinata (Linnaeus).

Asterias pectinata, Linnaeus, 1758, Syst. Nat. ed. X, p. 663.
Comatula pectinata, A. H. Clark, 1908, Proc. U.S. Nat. Mus. XXXIII, p. 685.

There are eight specimens of this common species. One is a fine individual from St. XXII, 13½ fms., while three notable specimens with arms 150 mm. long or more were taken at St. IX, 12–14 fms. These three were, in life, "red with white markings." Two specimens from St. XII, taken with *Amphimetra jaquinoti*, were also red and white. The other two specimens are from St. XIV, 19 fms. It is interesting that no specimens of the small, perhaps depauperate form of *pectinata*, known as *purpurea*, were taken by the Expedition, for that form is very common at the Murray Islands (where typical *pectinata* is rare), and has been taken as far south as Port Denison. Judging from the "Key Chart of Low Isles," one would certainly expect to find *purpurea* at several places, especially on the western side.

Comatula rotalaria, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 534.

There is a single specimen with 20 arms well over 150 mm. long. There are no cirri, and the dorsal apex is perfectly smooth, but the oral surface of the disk is covered with

projecting, fleshy, tubercle-like prominences, which are wanting in the specimens of *solaris* from the same place, St. XIV, 19 fms.

Comatula solaris, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 533.

There are five specimens of this fine species, of which four were taken at St. XIV, 19 fms., and one at St. IX, 12–14 fms. The cirri are few, with only 15 or 16 segments. The arms are 125–150 mm. long and range from moderately to very stout ($4\frac{1}{2}$ mm. wide). The colour is very diverse, no two of the specimens being alike; one is uniformly dark purple, another is dirty brown with pinnules yellow, another " yellow with pinnules brown, edged with white," and another " grey, white striped " (a white longitudinal stripe on dorsal side of arm).

Comantheria alternans (Carpenter).

Actinometra alternans, P. H. Carpenter, 1881, Notes Leyden Mus. III, p. 208.
Comantheria alternans A. H. Clark, 1911, Notes Leyden Mus. XXXIII, p. 176.

Two large comatulids from St. IX, 12–14 fms., with about 43 arms, 150–170 mm. long, seem nearer to this species than to any other, but they are certainly not typical specimens. They might be referred equally well to *C. polycnemis*, A. H. Clark, but as that species is not known from south of the Kei Islands, it seems better to call them *alternans*. The disks are very large, the discarded visceral mass measuring 34 by 22 mm. The II Br. series are 4 (3 + 4), or rarely 2; III Br. series, 2; IV Br. series, when present, 2; but there are altogether only three or four IV Br. series visible. Cirri are wanting in one specimen; in the other, 5 or 6 weak ones are present, but all are broken; they have segments 4, 5 and 6 markedly longer than wide, cylindrical and smooth, and are obviously different from those of *briareus*. The general appearance of these specimens is stouter than that of *briareus*, and resembles closely that of *alternans* from the Murray Islands. The colour is uniformly bright brown, except for being more yellow at distal points.

Comanthus timorensis (J. Müller).

Alecto timorensis, J. Müller, 1841, Mber. K. Preuss. Akad. Wiss. p. 186.
Actinometra annulata, Bell, 1882, Proc. Zool. Soc. Lond. p. 535, pl. xxxv.
Comanthus timorensis, A. H. Clark, 1931, Bull. U.S. Nat. Mus. LXXXII, I, pt. 3, p. 159 (603), pl. lxiv, fig. 181; pl. lxxv, fig. 204; pl. lxxvi, fig. 205; pl. lxxvii, figs. 206, 207.

There are only four specimens of this common Australian comatulid in the collection. They are very much alike, about 200 mm. across in life, and of a deep olive-brown colour. All are from Anchorage Reefs, Low Isles.

Comanthus bennetti (J. Müller).

Alecto bennetti, J. Müller, 1841, Mber. K. Preuss. Akad. Wiss. p. 187.
Comanthus bennetti, A. H. Clark, 1909, Vidensk. Medd. naturh. Foren. Kjöb. p. 147.

There is a single young individual in the collection from St. XVII, 19 fms. The more mature of the 30 arms are 90–100 mm. long ; 10 of the arms, in five pairs, are very young. There are 18 cirri with 21–27 segments, not very unlike those of an adult. The colour is a dull olive-brown, in some areas with a distinctly bluish cast ; the longer arms have a broad, longitudinal whitish band on the distal third. The cirri are yellow and the very young arms are cream-yellow.

Comanthus parvicirra (J. Müller).

Alecto parvicirra, J. Müller, 1841. Mber. K. Preuss. Akad. Wiss. p. 185.
Comanthus parvicirra, A. H. Clark, 1908, Smithson. Misc. Coll. LII, p. 203.

To this widespread, common, but imperfectly understood comatulid I am referring fourteen specimens, several of which are really too young for specific determination, but most probably belong here. At present we do not know how to distinguish young *parvicirra* from young *timorensis*. Several of the specimens are so damaged that the number of arms cannot be determined. In the remainder, the number ranges from 14 to 23. More than half of the specimens have no cirri, while the others have from 3 to 6 weak and insignificant ones. The colour is variable, but is usually light ; in one case " dominantly grey with white stripes," in others " light brown," or again handsomely cross-banded, light and dark. Ten of the specimens are from St. XIV, 19 fms., two are from St. XVI, 20 fms., one is from St. XVII, 19 fms., and one from St. XXII, 13½ fms.

Comanthus samoana, A. H. Clark.

A. H. Clark, 1909, Proc. U.S. Nat. Mus. XXXVII, p. 30.

There is a single *Comanthus*, which is evidently of this species. It is about 150 mm. in diameter, dark olive-brown, with 21 arms and 14 short, rather stout cirri.

Zygometra microdiscus (Bell).

Antedon microdiscus, Bell, 1884, Rep. Zool. Coll. " Alert," p. 163, pl. xv.
Zygometra microdiscus, A. H. Clark, 1909, Zool. Anz. XXXIV, p. 367.

A small comatulid from St. XXIII, 8 fms., has perplexed me very much. It is in poor condition, with many arms and nearly all the cirri broken or missing. The arms are about 60 mm. long, with all division series 4 (3 + 4) ; III Br. series present on one arm. The colour is deep reddish-purple. Mr. Austin H. Clark, the well-known authority on crinoids, thinks this individual may best be regarded as a " dwarf *Zygometra microdiscus*."

Zygometra punctata, A. H. Clark.

A. H. Clark, 1912, Proc. Biol. Soc. Wash. XXV, p. 24.

There are three specimens of this interesting and somewhat puzzling species ; one, with arms 75–80 mm. long, has a label, " G.B.R.E. Sept. 6, 1928, 11.30 a.m. North of island, about 9 fms. Rectangular dredge. Yellow with black markings. Bottom mud " ;

a second with 21 arms of about the same length has a label. "*Comanthus* sp. Low Id.," and is dull buff, spotted or, distally on the arms, banded with purple; the third, with only 11 arms, the single II Br. series 2, the cirri with about 20 segments, several of which are long, the colour "dark and pale brown" is from St. XVI, 20 fms., and is doubtfully referred to this species.

Heterometra crenulata (Carpenter).

Antedon crenulata, P. H. Carpenter, 1882, J. Linn. Soc. Zool. XVI, p. 507.
Heterometra crenulata, A. H. Clark, 1918, "Siboga" Exped., The Unstalked Crinoids, XLIIb, p. (77), 78.

The single specimen of this species has arms about 80 mm. long and its label reads, "Crinoid. Greyish-brown. St. IV. Dredge. 70% alcohol."

Heterometra nematodon (Hartlaub).

Antedon nematodon, Hartlaub, 1890, Nachr. Ges. wiss. Göttingen, Mai, p. 185.
Heterometra nematodon, A. H. Clark, 1911, Mem. Aust. Mus. IV, 15, p. 768.

A small comatulid, about 125 mm. across, with 37 arms and 18 cirri, having 40 segments, seems to be of this species. The colour is fawn, darker orally. The label reads: "St. XIII. 7 March 29. Dark brown with white patches. Dredge. Alcohol."

Amphimetra jacquinoti (J. Müller).

Comatula jacquinoti, J. Müller, 1846, Mber. K. Preuss. Akad. Wiss. p. 178.
Amphimetra jacquinoti, A. H. Clark, 1918, "Siboga" Exped., The Unstalked Crinoids, XLIIb, p. 85.

There are four specimens of this species in the collection, two being taken at St. XII, one at St. XIII, and one "north of island, about 9 fms." The smallest has the arms slender and only 70–80 mm. long, there are but 27 or 28 segments in the cirri, and twelve in P_2; the colour is very pale reddish, almost white dorsally. This specimen answers well on the whole to the description of *A. pinniformis* (P. H. C.) and I am inclined to think that supposed species is really based on young specimens of *jacquinoti*. The other specimens are larger and stouter, with arms 100–125 mm. long. They are reddish-white dorsally, and more or less deep red orally; in one case the whole specimen is uniformly dull red, but it may have been stained in the alcohol. One specimen is said to have been "purple and yellow" in life; apparently the purple has become red, and the yellow whitish, as the result of preservation.

Lamprometra gyges (Bell).

Antedon gyges, Bell, 1884, Rep. Zool. Coll. "Alert," p. 160, pl. xii, figs. B, *a*, *b*.
Lamprometra gyges, A. H. Clark, 1913, Proc. Biol. Soc. Wash. XXVI, p. 144.

A single adult specimen, more or less broken, but in fair condition, with arms 60–75 mm. long, and of a deep red-purple colour, has the labels: "G.B.R.E. General Survey, 24/4/29, A4," and "*Dichrometra tenera* (Hartlaub), 1 spec. H. L. Clark, St. XVII."

This is apparently a specimen seen by me in Sydney in November, 1929, and given Hartlaub's name, which is a synonym of *gyges*. Obviously one of the labels is wrong as to locality, and I believe the specimen came from A4.

Oligometra carpenteri (Bell).

Antedon carpenteri, Bell, 1884, Rep. Zool. Coll. "Alert," p. 157, pl. x, figs. A, *a–c*.
Oligometra carpenteri, A. H. Clark, 1908, Proc. Biol. Soc. Wash. XXI, p. 126.

This characteristic species of northern Australia is represented in the collection by a single small adult, light brown, arms faintly banded (distally) or striped (proximally), from St. XIV, 19 fms.

Iconometra anisa (H. L. Clark).

Oligometra anisa, H. L. Clark, 1915, Pap. Dept. Mar. Biol. Carn. Instn. VIII, p. 105.
Iconometra anisa, A. H. Clark, 1929, J. Linn. Soc. Zool., XXXVI, p. 643.

There are two small dark-coloured specimens of this species in the collection taken at St. XIX, 10 fms. As *anisa* was known previously only from the Murray Islands, it is interesting to record this slight extension of its range.

Colobometra perspinosa (Carpenter).

Antedon perspinosa, P. H. Carpenter, 1881, Notes Leyden Mus. III, p. 178.
Colobometra perspinosa, A. H. Clark, 1909, Proc. Biol. Soc. Wash. XXII, p. 6.

An interesting comatulid taken in "Penguin Channel, 16 fms. Mud. 21/12/28," in only fair condition, seems to be best referred to this species, but the 18 cirri have only 40–48 segments and the whole animal is less spiny than usual. It is thus nearer to the East Indian species *vepetrum*, but as I doubt whether *vepetrum* is valid, it seems best to call this specimen *perspinosa*, the species previously known from the east coast of Australia.

OPHIUROIDEA.

The collection of 162 brittle-stars is of very great interest, as it includes one species and one variety (*Ophiocoma delicata, Ophiarthrum elegans* var. *unicolor*) here described for the first time and three genera not hitherto known from Australia (*Ophiomitra, Ophiurodon, Cryptopelta*). There are also two species now recorded from Australia for the first time (*Ophiocnida echinata, Ophiomastix bispinosa*) and two others never before reported from Queensland (*Ophiomyxa australis, Amphioplus lobatus*). It is interesting to note that these two species are both from the south. About one-third of the 28 forms in the collection are therefore additions to the Queensland marine fauna, and this fact again emphasizes the great richness of that fauna, which is still imperfectly known. Eight of the forms are Ophiocomids and six are Ophiodermatids, so that half of the brittle-stars collected belong to those two families. Dredging in deep water at St. XV, 210 fms., yielded the genera *Ophiomitra* and *Ophiurodon* here recorded for the first time from Australia, but no other Ophiurans were taken there.

Ophiomyxa australis, Lütken.

Lütken, 1869, K. Danske Selsk. Vidensk. Skr. (5), VIII. hft. 2. p. 99. [Reprinted, Additamenta ad Hist. Ophiuridarum, pt. 3, p. 99.]

This widely distributed brittle-star has not previously been found on the Australian coast north of New South Wales, nor was it found at Low Isles, so its occurrence at Sts. XIV, XVI and XVII in some numbers (26 specimens) is really quite remarkable. But as it is found in Fiji and is known also from Southern Japan, its occurrence near Lizard Island is not inexplicable.

Euryale asperum, Lamarck.

Lamarck, 1816, Anim. s. Vert. II, p. 538.

A single small specimen, only 13 mm. across the disk, represents this common species. It is dark reddish-brown in colour and was taken at St. XII, 10–15½ fms.

Ophiomitra dives, Koehler.

Koehler, 1922, Bull. U.S. Nat. Mus. C., V, p. 107, pl. x, figs. 1–4; pl. xciv, fig. 2.

A single brittle-star, 14 mm. across the disk, taken at St. XV, 210 fms., represents this species, hitherto known only from a single station in the Philippine Islands. The Australian specimen is smaller and lighter coloured than Koehler's types. It is dry and probably more or less bleached but there is still a reddish tinge, and the dark longitudinal line on the upper surface of the arms is very evident. There are some trifling differences in the under arm-plates, but otherwise the resemblance to the Philippine specimens is striking.

Ophiurodon cupidum (Koehler).

Ophioconis cupida, Koehler, 1905, "Siboga" Exped., XLV*b*, Ophiures littorales, pt. 2, p. 15, pl. i, figs. 19, 20.
Ophiurodon cupida, Matsumoto, 1915, Proc. Acad. Nat. Sci. Philad., LXVII, p. 84.

A brittle-star, taken at St. XV, 210 fms., with all the arms broken off close to the badly damaged disk, which is 7 mm. across, is undoubtedly an *Ophiurodon*, a genus new to the Queensland coast, but it is impossible to say positively what the species is. In my opinion it is nearest to the East Indian species *cupidum*, and it may for the present rest under that name.

Amphioplus lobatus (Ljungman).

Amphipholis lobata, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 315.
Amphioplus lobatus, H. L. Clark, 1915, Mem. Harv. Mus. Comp. Zoöl. XXV, p. 258.

This species was originally described from a specimen only 6 mm. across the disk taken by Kinberg on the coast of New South Wales, near Sydney. So far as I know it has not been met with since. In the present collection are two brittle-stars, clearly *Amphioplus*, taken at St. XXV, 20–25 fms., which correspond so well to Ljungman's brief Latin description that I do not feel warranted in separating them as a different species.

One has the disk 8 mm. across and the arms are about 60 mm. long; the other is slightly smaller and lacks the disk. In the characters of the oral shields, arm-spines, arm-plates, adoral plates and oral papillae, the smaller specimen corresponds very closely to Ljungman's description, but the larger one has the lower armplates more nearly square and the oral shields are much elongated, about twice as long as wide. In both specimens there are six arm-spines on the proximal part of the arm, but distal to the eighth–tenth joint there are but five; beginning about the thirty-fifth segment there are distally but four. The next to the lowest spine is the longest and stoutest, but the lowest is nearly, and sometimes quite, its equal; where there are six spines the four uppermost are more slender than the two lowest. The scaling of the disk dorsally is coarse but rather even, about 25–30 to a square millimetre; on the interbrachial areas below it is much finer. The infra-dental oral papilla is thick and not scale-like; of the other three, the middle one is largest and most scale-like. The radial shields are straight, with distal ends slightly thickened, but very little wider than the proximal, fully $2\frac{1}{2}$ times as long as wide. Both specimens are nearly white in colour, but the disk is distinctly pearl grey.

Ophiocnida echinata (Ljungman).

Ophiophragmus echinatus, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 316.
Ophiocnida echinata ?, Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 230, pl. iv, figs. 22, 23.

A single small specimen (disk 4 mm. across, arms 50–60 mm. long) of this species was taken at St. XXV, 20–25 fms. The disk is pale grey and the arms are nearly white with about 15 cross-bands of dull light brown, irregularly placed, but usually well spaced. Compared with a specimen of about the same size from the Philippines, the banded arms give it a noticeably different appearance, but I do not think the difference is of any real significance. The species has not been taken previously south of the East Indies.

Ophiactis savignyi (Müller and Troschel).

Ophiolepis savignyi, Müller & Troschel, 1842, Syst. Asteriden, p. 95.
Ophiactis savignyi, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 323.

Eleven specimens of this tropicopolitan species were taken at the following places: One 5-armed adult, with disk 6 mm. across and arms 20 mm. long, in 4 fms., $\frac{1}{4}$ mile south of Cape Kimberly; five young 6-armed ones, Gen. Survey, 6.iv.29, Mangrove Park, and one similar specimen, 24.iv.29, Mangrove Park; three young ones from St. X, 14–17 fms., 22.ii.29, and one from St. XXV, 20–25 fms.

Ophiothrix longipeda (Lamarck).

Ophiura longipeda, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiothrix longipeda, Müller & Troschel, 1842, Syst. Asteriden, p. 113.

This common but as yet ill-defined species was taken at the following places: Two at Low Isles; one at St. IX, 12–14 fms.; one at St. XII, 10–$15\frac{1}{2}$ fms.; one, young with disk only 6 mm. across, at St. XXIII, 8 fms.; and one, not typical, and referred to *longipeda* with some doubt, at St. XIX, 10 fms.

Ophiothrix martensi australis, H. L. Clark.

H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 111, pl. xv, fig. 4.

A single fine specimen, 12 mm. across the disk, was taken with the trawl at St. XVII, 19 fms.

Ophiothrix nereidina (Lamarck).

Ophiura nereidina, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiothrix nereidina, Müller and Troschel, 1842, Syt. Ast. p. 115.

This beautiful brittle-star was taken in some numbers near Lizard Island, but apparently was not found at Low Isles. There are five specimens, 6–9 mm. across the disk, from St. XIV, 19 fms.; five, 5–10 mm. across, from St. XVI, 20 fms.; and eight, 6–9 mm. across, from St. XVII, 19 fms.

Ophiothrix stelligera, Lyman.

Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 237, pl. iii, figs. 15–20.

This species is represented by only four specimens, and one of these, taken at St. XXV, 20–25 fms., is only 3 mm. across the disk and somewhat decalcified, so that its identity is not beyond question. A small adult, taken at St. XVI, 20 fms., is labelled "red ophiuroid from red sponge"; both colour and habitat are characteristic of *stelligera*. The other two specimens are large adults, 8 mm. across the disk; one, from St. XVII, 19 fms., is pale brown, the other, from "off North Anchorage, low tide, 9 fms., 17.x.28," is deep, dull blue-violet; in both specimens the longitudinal white stripe on the upper side of the arm, so characteristic of the species, is very evident.

Ophiothrix striolata, Grube.

Grube, 1868, Jber. Schles. ges. vaterl. Kult. XLV, p. 45.

A single specimen of this species, 5 mm. across the disk, but with arms over 50 mm. long, was taken at Linden Bank, Sts. II and III, 28 fms., 24.xi.28.

Ophionereis semoni (Döderlein).

Ophiotriton semoni, Döderlein, 1896, Denkschr. Med.-naturw. Ges. Jena, VIII, p. 288, pl. xv, figs. 8, 8*a*.
Ophionereis semoni, Koehler, 1905, "Siboga" Exped. XLV*b*, Ophiures littorales, pt. 2, p. 54.

A very small brittle-star, 3 mm. across the disk, from St. XXII, 13½ fms., extends the known range of this species on the Queensland coast a little to the south.

Ophiocoma brevipes, Peters, var. *variegata*, E. A. Smith.

Ophiocoma brevipes, Peters, 1851, Mber. K. Preuss. Akad. wiss. Berlin, p. 465.
Ophiocoma variegata, E. A. Smith, 1876, Ann. Mag. Nat. Hist. (4), XVIII, p. 39.
Ophiocoma brevipes, var. *variegata*, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 130.

There is a single *Ophiocoma* in the collection which represents this protean variety. It is a very fine example, 23 mm. across the disk, of forma *dentata*, Lütken, and was taken at Gen. Survey, A4, 24.iv.29.

Ophiocoma delicata, sp. nov.

(Plate I, figs. 1–3.)

Disk 9 mm. in diameter ; arms five, slender, somewhat flattened, about 60 mm. long and only $1\frac{1}{2}$ mm. wide basally. Disk distinctly pentagonal, very flat, closely covered both above and on the interbrachial areas below with a coat of very small granules, none of which are at all elongated or spiniform ; on the upper surface of the disk there are 100 or more granules to a square mm., but adorally they are larger, and near the oral shields there are, in a similar area, about 60–70. No indication of radial shields. Upper arm-plates distally triangular, but with a very rounded distal margin, much longer than wide, well separated from each other ; at the middle of the arm they are fully in contact, the proximal angle being more or less truncated ; basally they are a little wider (1·2 mm.) than long (1 mm.), nearly square, with distal corners rounded, in contact for their full proximal width. Oral shields triangular with angles rounded, about as wide as long (1·3 mm.) ; madreporite with proximal angle more rounded than in the other plates, but not essentially different. Adoral plates long and narrow, not meeting either proximally or distally, widest distal to middle. Oral papillae 5 or 6 on each side, the inner ones spiniform, the distal wider and flatter. Tooth-papillae few and small (1 or 2 to 4 or 5), not forming a well-defined cluster below the column of 5 (or possibly 6) narrow, blunt and rounded teeth. First under arm-plate small (about ·8 mm. wide) diamond-shape, wider than long, with proximal and distal angles rounded or truncate ; second much larger, a trifle longer than wide, rounded pentagonal, with distal margin convex and lateral margins slightly concave ; succeeding plates similar, but larger and relatively wider, about a millimetre each way, at first broadly in contact, but rapidly becoming much less so ; distally the plates become hexagonal, well separated from each other and very much longer than wide. Side arm-plates relatively rather large, especially distally ; each carries 4 basally (distally only 3) long, slender, acuminate arm-spines, of which the uppermost and lowest are more or less nearly equal, and are distinctly the longest, sometimes equalling two full arm-segments in length ; the spines are fragile, but not hollow, and are never stout or clavate. Tentacle-scales 2, thin and flat, the outermost distinctly the widest, and overlying the base of the lowest arm-spine. Colour (dried specimen) : Disk, pale brown with forty or more dark brown spots, rounded, oval, or elongated, each of which is margined with white ; interbrachial areas below, similar ; upper arm-plates and proximal half of side arm-plates rather dark purplish-brown, with distal margin and distal part of lateral margins of upper plates and distal half of side-plates nearly white ; distally the whole upper plate becomes white, and the arms are then cross-banded with equal areas of brown and white ; the basal and the distal under arm-plates are white, but all of the large ones beyond the small basal ones have only the marginal portions light, the central area being purple brown ; area about mouth nearly white, but each oral shield has two (in one case only one) large purplish-brown spots, irregularly placed ; arm-spines nearly white, but each one has a more or less evident (generally faint) longitudinal, narrow dusky line, or a series of minute spots, on its upper side.

The specimen upon which the above description is based was taken with the dredge at St. XVII, 19 fms. Owing to the granulation of the disk and the two tentacle-scales, I was at first inclined to call it a colour variety of *brevipes* var. *variegata*, but comparison with many specimens of that form satisfied me. it could not properly be so treated. It differs from all specimens of *brevipes* in the shape and proportion of disk and arms, in the character of the arm-plates and spines and in the way in which the outer tentacle scale overlies the base of the lowest arm-spine. unlike any known *Ophiocoma*. The very scanty development of tooth-papillae made me suspicious that this brittle-star might be an ophiodermatid rather than an ophiocomid, but all of its characters except those of teeth and tooth-papillae are so obviously those of an *Ophiocoma*. I think it must be referred to that genus. As it is much more slender and fragile than any other species of the genus, the name *delicata* seems appropriate.

I regard as a young individual of this species a small and rather badly damaged brittle-star, with the disk only 4·5 mm. across and all the arms broken. The appearance and coloration of the arms is like that of the distal part of the arms in the large specimen. The colour of disk and oral shields is also like that of the adult, but there are very few granules anywhere on the disk (which may be due to youth, as is the case in *Ophiocoma riisei*), and there are apparently no tooth-papillae (which may also be a youthful condition). This little specimen is too young to show even its family characters clearly, but I have no doubt it is a youthful specimen of *delicata*. It was taken at St. XIV, 19 fms.

Ophiocoma scolopendrina (Lamarck).

Ophiura scolopendrina, Lamarck, 1816, Anim. s. Vert. II, p. 544.
Ophiocoma scolopendrina, Müller and Troschel, 1842, Syst. Asteriden, p. 101.

There are sixteen specimens of this very common species from the following places: Three Isles, 6.v.29. Low Isles. The Middle Moat, 21 and 22.ii.29. Gen. Survey, C1, 8.iii.29. Gen. Survey, Low Isles. Gen. Survey, 20.iii.29. Three Isles, 5.v.29.

Ophiomastix annulosa (Lamarck).

Ophiura annulosa, Lamarck, 1816, Anim. s. Vert. II, p. 543.
Ophiomastix annulosa, Müller and Troschel, 1842, Syst. Ast. p. 107.

One specimen from the south-west reef of Mer, Murray Islands: two others are presumably from the same place. A fourth specimen is from "Ribbon Reef, seaward sloping zone. 4.vi.29." Apparently the species does not reach as far south as Low Isles.

Ophiomastix bispinosa, H. L. Clark.

H. L. Clark, 1917, Bull. Mus. Comp. Zoöl. Harv. LXI, p. 442, pl. ii, figs. 1, 2.

An *Ophiomastix*, 15 mm. across the disk, with arms about 90 mm. long, from St. XIV, 19 fms., apparently represents the adult of this species, hitherto known only from a single young individual, 5 mm. across the disk, taken at Makemo in the Paumotus. Its occurrence on the Australian coast is most interesting. The dull olive-brown colour (dry) with

the distal portion of the arms banded (at intervals of 4–6 segments) with a dirty whitish, and many of the arm-spines faintly annulated, is very similar to that of the holotype. The single, almost circular tentacle-scale is a striking feature, while the form of the oral shields (widest distal to middle) and the shape of the upper and under arm-plates (on the distal part of the arms, of course) are suggestive of the original specimen. Proximally the arm-plates, both above and below, are wider than long and more or less in contact. The arm-spines are usually 3, but proximally there are often 4 (with the uppermost much the longest and heaviest, though it is scarcely claviform), and occasionally only 2; distally there are never 4, but frequently only 2. The disk covering shows a marked difference from that of the holotype, in that the spinules are very numerous and rather uniformly short and sharp; more numerous and smaller near the margins of the disk than at the centre. This difference between the Australian and Makemo specimens is probably due to the youthfulness of the latter.

Ophiarthrum elegans, Peters.

Peters, 1851, Mber. K.-Preuss. Akad. Wiss. p. 463.

There are eleven specimens of this common and very widespread brittle-star from the following places: Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29. Gen. Survey, F9, 4.iv.29. Gen. Survey, B2. Gen. Survey, B3. There are also two remarkable specimens, one from St. XIV, 19 fms., and one from St. XVII, 19 fms., which I am strongly tempted to consider representatives of an undescribed species, but have decided to call simply *O. elegans* var. *unicolor*, var. nov. These specimens have the entire disk above and below uniformly brown; in the smaller specimen (disk 12 mm. across) the shade is dark, but in the larger (16 mm.) it is a light greyish brown. The arms, about 5 times the disk diameter, are somewhat indistinctly banded, because at intervals of from 2 to 5 segments the upper arm-plate (or two consecutive plates) and the adjoining parts of the side arm-plates are dull cream-colour. The arm-spines are noticeably long, slender, and more or less evidently flattened; the uppermost is often nearly or quite equal to three arm-segments. There are dusky spots and bands on the arm-spines and a sprinkling of very fine blackish dots on the upper surface of the arms as in typical *elegans*. Owing to the slender arm-spines and the colour, these specimens appear quite unlike *elegans*, but a specimen in the M.C.Z. from New Guinea resembles them in both these respects, and yet has the margin of the disk and markings on the interbrachial areas of the lower surface distinctly light as in the usual form. This specimen is such a connecting link between *elegans* and *unicolor* that I am compelled to regard the latter as merely a variety of the former.

Ophiarthrum pictum (Müller and Troschel).

Ophiocoma picta, Müller and Troschel, 1842, Syst. Asteriden, p. 102.
Ophiarthrum pictum, Lyman, 1874, Bull. Mus. Comp. Zoöl. Harv. III, p. 225, pl. vii, figs. 2–4.

This beautiful brittle-star seems to be common at Low Isles, as there are seven specimens from the following places: Gen. Survey, Mangrove Park, 6.xi.29; the Western Moat on *Hippopus*, 13.xi.28. There are also some arm-fragments from "The Fungia Moat, among dead colonies of branched *Porites*, 6.iv.29." A small specimen

14 mm. across the disk was dredged at St. XVI, 20 mm. Several specimens are very fine, one, 31 mm. across the disk, particularly so ; this is the largest specimen of *pictum* I have yet seen, and in life was about 35 mm. across the disk, and had arms more than 200, probably more than 250 mm. long.

Ophiarachna incrassata (Lamarck).

Ophiura incrassata. Lamarck, 1816, Anim. s. Vert. II, p. 542.
Ophiarachna incrassata, Müller and Troschel, 1842, Syst. Asteriden, p. 104.

This magnificent species is represented by three specimens, 43–45 mm. across the disk, of which one is from Low Isles, and the other two have no labels.

Pectinura yoldii (Lütken).

Ophiopeza yoldii, Lütken, 1856, Vidensk. Medd. naturh. Foren. Kjöb. p. 9.
Pectinura yoldii, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 119.

A single specimen, 17 mm. across the disk, from St. XXI, 10 fms., represents this species.

Ophiochasma stellatum (Ljungman).

Ophiarachna stellata, Ljungman, 1867, Öfvers. K. K. Vet.-Akad. Förh. XXIII, p. 305.
Ophiochasma stellata, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 121.

Four specimens of this species were taken at Stations XXII, XXIII, XXIV, in 8–16½ fms.

Ophiarachnella gorgonia (Müller and Troschel).

Ophiarachna gorgonia, Müller and Troschel, 1842, Syst. Asteriden, p. 105.
Ophiarachnella gorgonia. H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 123.

There is a single specimen from Gen. Survey, the Thalamita Flat, 21.iv.29.

Ophiarachnella infernalis (Müller and Troschel).

Ophiarachna infernalis, Müller and Troschel, 1842, Syst. Asteriden, p. 105.
Ophiarachnella infernalis, H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 124.

There are 23 specimens of this common species in the collection, ranging in disk diameter from 4 to 12 mm. Only one was taken at Low Isles ; Gen. Survey, the Thalamita Flat, 21.iv.29. The others are from Sts. XIV, XVI, XVII, XIX and XXIII, in 8–20 fms.

Cryptopelta granulifera, H. L. Clark.

H. L. Clark, 1909, Bull. Mus. Comp. Zoöl. Harv. LII, p. 131.

There are two brittle-stars in the present collection which appear to be adults of this species, hitherto known only from the small holotype taken at Mauritius. The smaller individual has the disk 10 mm. across, the arms 45–50 mm. long, and 7 arm-spines at base

of arm, but the number soon drops to 6, and beyond the middle of the arm there are only 5. The disk is very light (dirty cream-colour), the arms olive grey, banded with a dark shade covering 7 or 8 segments, and then a light shade for about 4 ; the base of the arms is of the light shade ; the lower surface is uniformly whitish, or about the mouth, yellowish. This specimen was taken at St. XVII, 19 fms. At St. XIV, 19 fms. the larger specimen (12–13 mm. across the disk, arms 60–65 mm. long) was collected. It has 8 arm-spines at very base of arms, then 7 and then, from middle of arm on, only 6 ; at tip of arm there are but 5. The disk is light reddish-brown ; arms greyer and less distinctly banded than in smaller specimen ; lower surface fawn-colour, darkest on disk. In both specimens the first upper arm-plate is much wider than long, not at all circular as in the younger holotype. The flattening of the arms is marked, especially distally. The skin of the disk in these dry specimens is much wrinkled, which would indicate that in life the disk is somewhat soft and swollen.

The discovery of *Cryptopelta* near Lizard Island adds a new genus to the fauna of Australia, and is hence of very great interest. Koehler has described (1922, Bull. U.S. Nat. Mus., C, vol. v, p. 350) a species of *Cryptopelta* from the Philippines, which he calls *tecta*, closely resembling *granulifera*, but differing in having the first four or five of the basal under arm-plates covered by the fine granulation of the lower surface of the animal. In the Australian specimens these plates are perfectly bare and free from granules, so that they are apparently the Mauritian rather than the Philippine species.

Ophiolepis superba, H. L. Clark.

Ophiura annulosa, Blainville, 1834, Man. d'Act. p. 244, pl. xxiv, figs. 1–4 (*non* Lamarck, 1816).
Ophiolepis superba, H. L. Clark, 1915, Spolia Zeylan. X, p. 89.

This handsome brittle-star is apparently common at the Low Isles, for there are ten specimens in the collection, with disks from 17 to 32 mm. across. They are labelled : Gen. Survey, the Thalamita Flat ; Gen. Survey, A4, 10.iv.29. The only one which calls for any comment is an individual 25 mm. across the disk, the arms ranging from 25 to 75 mm. The colours are very dull, more or less tinged with olive, and I am uncertain whether this is artificial or not. The scaling of the disk is smoother than in the other specimens and has a peculiar appearance, so that I am inclined to think the peculiar colouring may be natural and due to some unusual feature of the environment.

ECHINOIDEA.

The collection of sea-urchins contains 154 specimens, representing 28 species of 23 genera, which is a very fair proportion of the Echini known from Queensland. Two genera (*Micropyga*, *Pericosmus*) are added to the fauna of Australia, and three additional species (*Nudechinus multicolor*, *Laganum dyscritum*, *Metalia spatagus*) are new to the continent ; of these the *Laganum* is new to science. The genus *Gymnechinus*, represented by the species *epistichus*, is also now definitely added to the Australian fauna, for while this species was supposed when described to occur in Australian waters, it is now for the first time reported from a definite locality. Dredging in deep water at St. XV, 210 fms. yielded the most extraordinary specimens, both *Micropyga* and *Pericosmus* occurring there.

Prionocidaris bispinosa (Lamarck).

Cidarites bispinosa, Lamarck, 1816, Anim. s. Vert. III, p. 57.
Prionocidaris bispinosa (Lamarck) var. *aruana*, Döderlein, 1911, Abh. Senckenb. Naturf. Ges. XXXIV, p. 240.

This cidarid, so common on the northern coasts of Australia, was taken at only three places; at St. XXII, 13½ fms., an adult specimen, 40 mm. in diameter, the biggest spines less than 60 mm. long, and a young one, about half as large, were dredged; at St. XIV, 19 fms., a young one only 9 mm. in diameter was taken; and "north-east of Low Isles, about 8 fms., mud bottom, with stones, Sept. 1928," a young one, 20 mm. in diameter, with spines 35 mm. long was collected. None of these specimens calls for any special comment.

Prionocidaris verticillata (Lamarck).

Cidarites verticillata, Lamarck, 1816, Anim. s. Vert. III, p. 56.
Prionocidaris verticillata, Döderlein, 1911, Abh. Senckenb. Naturf. Ges. XXXIV, p. 243.

A particularly fine specimen of this striking sea-urchin was taken on the Low Isles reef, 6.vi.29; it is 30 mm. in diameter and the longest primaries are 27 mm. long, each with 3 of the characteristic whorls. The colour is less green than usual, but the oral primaries and the tips of the aboral ones are evidently greenish; shafts of upper primaries between whorls, rose-reddish; secondaries light, greenish-yellow with a dusky greenish blotch near tip and with a distinctly reddish or orange cast, especially at tip.

I cannot follow Mortensen in putting this species in a genus by itself, nor can I admit that if this were done, the name *Plococidaris* might be used; that name is an unquestionable synonym of *Prionocidaris*.

Centrechinus savignyi (Michelin).

Diadema savignyi, Michelin, 1845, Mag. Zool. (2), VII, p. 15.
Centrechinus savignyi, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, pp. v and 145, pl. xvii, figs 1, 2.

Four very young specimens of *Centrechinus*, 6–20 mm. in diameter, taken in the "General Survey, Low Isles," are to be referred to this species, as they show no white anywhere, and the very light-coloured spines are banded with purplish-red, much brighter than the brown of *setosus*. The smallest specimen bears the additional label "A4 24.iv.29."

Centrechinus setosus (Leske).

Echinometra setosa, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 36.
Centrechinus setosus, Jackson, 1912, Mem. Boston Soc. Nat. Hist. vii, p. 28 (*partim*). H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, pp. v and 146, pl. xvii, figs. 3, 4.

This species also occurs at the Low Isles, but there is only a single specimen in the present collection. It is 18 mm. in diameter, with spines 36 mm. long; the latter are handsomely banded with wood-brown and white.

Echinothrix calamaris (Pallas).

Echinus calamaris, Pallas, 1774, Spic. Zool. I, fasc. 10, p. 31, pl. ii, figs. 4–7.
Echinothrix calamaris, Peters, 1853, Mber. K. Preuss. Akad. p. 484.

There are two adult specimens, one from Low Isles, and the other from "Outer Barrier, Yonge Reef, Inner Moat, 5.vi.29." Both have the interambulacral primaries fragile, hollow, black and white banded as is normal for *calamaris*, but the Low Isles specimen has the ambulacral primaries bright brown as in *E. diadema* and not the usual yellowish-green of *calamaris.*

Micropyga tuberculata, A. Agassiz.

A. Agassiz, 1879, Proc. Amer. Acad. Arts Sci. XIV, p. 200.

Dredging at St. XV, 210 fms., yielded a fine specimen of *Micropyga*, a genus new to Australia. It is 70 mm. in diameter, light reddish-purple (bright when wet) in colour, and has numerous club-shaped primary spines just below the ambitus. Comparison with cotypes of *tuberculata* from Cebu, P. I., shows it to belong to that species, but the tuberculation is surprisingly like that of *M. nigra*, as shown in the published figures of that species (H. L. Clark, 1925, Cat. Recent Ech. Brit. Mus., pl. iv). The question naturally rises whether the supposed differences in tuberculation between *nigra* and *tuberculata* have any validity ; if not, is *nigra* entitled to any recognition as a species, or is it only a colour form ?

Stomopneustes variolaris (Lamarck).

Echinus variolaris, Lamarck, 1816, Anim. s. Vert. III, p. 47.
Stomopneustes variolaris, Agassiz, 1841, Mon. d'Ech., Observ. Progrès Récens. Hist. Nat. Éch. p. 7.

Two specimens were taken at Low Isles ; one is an adult, about 53 mm. in diameter, with short, stumpy primaries, the longest 30 mm. in length by 3 mm. in thickness, abruptly pointed, appearing as though they had been broken off and then the tip had regenerated ; the other specimen, "Gen. Survey, 7.iii.29," is a young one, only 22 mm. in diameter.

Temnopleurus toreumaticus (Leske).

Cidaris toreumatica, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 155, pt. x, figs. D, E.
Temnopleurus toreumaticus, Agassiz, 1841, Mon. d'Ech., Observ. Progrès Récens. Hist. Nat. Ech. p. 7.

At St. IX, 12–14 fms., a very fine specimen of this handsome urchin was taken. It is 32 mm. in diameter and the longest primaries are 23 mm. The test is very light olive, the primaries olive banded near tip with a lighter shade ; many of the small primaries, especially orally, are banded their whole length ; secondary and miliary spines very light, often nearly white, the larger ones faintly banded. The primary spines are notably slender and acuminate.

Salmacis belli, Döderlein.

Salmacis sphaeroides, var. *belli*, Döderlein, 1903, Denkschr. med.-naturw. Ges. Jena, VIII, p. 718.
Salmacis belli, Mortensen, 1904, K. Danske Vidensk. Selsk. Skr. (7), I, p. 68.

A good specimen of this lovely species was taken at St. XII. 10–15½ fms. It is 74 mm. h.d. by 43 mm. v.d. Most of the spines above the ambitus are broken or wanting, but orally and especially about the peristome they are still present. The test is a very light reddish-fawn colour, while the spines are green at base, becoming rose-red distally; at ambitus and below, the tips are crossed by one or two broad whitish bands; these are most marked on the oral primaries with their conspicuously wide and flattened tips, 1·5–2 mm. across.

Salmacis sphaeroides (Linnaeus).

Echinus sphaeroides Linnaeus, 1758, Syst. Nat. ed. X, p. 664.
Salmacis sphaeroides. Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 69, pl. ii, figs. 1–3.

There are two specimens from St. XIX, 10 fms., one from Batt Reef, and one from Low Isles. The two latter and one from St. XIX are typical dark-coloured specimens, 60–80 mm. in diameter, but the second specimen from St. XIX, which is 75 mm. h.d. and 50 mm. v.d., has a peculiar appearance which may possibly be artificial. The test is pale grey violet, but this seems to be a superficial layer which rubs off easily, leaving the usual variegated light and dark green; spines almost white (a very pale reddish-lavender) banded, distally at least, with deep crimson.

Salmacis virgulata alexandri, Bell.

Salmacis virgulata, Agassiz and Desor, 1846, Ann. Sci. Nat. VI, p. 359.
Salmacis alexandri. Bell, 1884, Rep. Zool. Coll. "Alert," p. 118.
Salmacis virgulata alexandri, Döderlein, 1914, Michaelsen and Hartmeyer, Fauna Südwest-Austral. IV, p. 454.

At St. XIX, 10 fms., along with the preceding *Salmacis*, one typical specimen of this Australian subspecies was taken. It is 52 mm. h.d. by 35 mm. v.d.; the actinal spines are bright red violet, green at base, with sharply defined white tips; adapically the green becomes more and more dominant, until at the periproct the small spines are wholly green.

Temnotrema decorum, Döderlein.

Döderlein, 1914, Michaelsen and Hartmeyer, Fauna Südwest-Austral. IV, p. 459.

Although this lovely little urchin was not taken at the Low Isles, there are three specimens in the collection, two from St. XIX, 10 fms., and one from St. XXIII, 8 fms. They are all adult, ranging from 23 by 15 mm. to 26 by 18. They are light grey or greyish-olive, with the spines white or nearly so, many more or less green basally, each provided with one or two vermilion-red bands, which may be very distinct (orally) or very faint (adapically). This species has not previously been taken on the Queensland coast south of Torres Strait.

Tripneustes gratilla (Linnaeus).

Echinus gratilla, Linnaeus, 1758, Syst. Nat. ed. X, p. 664.
Tripneustes gratilla, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 77.

The single specimen of this common species is 93 mm. in diameter, with the test dark purple and the spines more or less nearly white.

Nudechinus darnleyensis (Tenison-Woods).

Echinus darnleyensis Tenison-Woods, 1878, Proc. Linn. Soc. N.S.W. II, p. 165.
Nudechinus darnleyensis H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 277.

A very small urchin, 4·5 mm. h.d., taken at St. XXI, 10 fms., seems to be undoubtedly the young of this species, which is known only from Northern Queensland. The primary spines are violet with white tips.

Nudechinus multicolor (Yoshiwara).

Echinus multicolor Yoshiwara, 1898, Ann. Zoöl. Jap. II, p. 60.
Nudechinus multicolor H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 276.

There are two small specimens of *Nudechinus* in the collection which are certainly not *darnleyensis*, but answer well to descriptions of *multicolor*, so that although they are too young for certain identification, I refer them with little hesitation to this Japanese species. The geographical problem involved is like that of *Temnotrema sculptum*, a species first described from Japan, but now known from Northern Australia also. Yoshiwara's type came from Akune, Satsuma Province, in Southern Japan, so the species is probably a warm-water form, with a considerable distribution in the East Indian region.

The smaller of the specimens before me is only 5 mm. in diameter, and was taken at Low Isles, " Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29." The larger is 8 mm. h.d. by 4·5 mm. v.d., and comes from " Three Isles, Gen. Survey, May 5, 1929." In both specimens the test is variegated with white, light green and dark green, while the spines are ringed with 2 or 3 (rarely 4) narrow, not sharply defined, dusky bands ; in the smaller specimen these bands have a faint violet tinge, which in the larger is more definitely violet (or possibly reddish) in colour. In the larger specimen ocular I is insert, but ocular V is scarcely so ; the younger specimen has not been cleaned for observation, but apparently all oculars are exsert.

Gymnechinus epistichus, H. L. Clark.

H. L. Clark, 1912, Mem. Harv. Mus. Comp. Zoöl. XXXIV, p. 289, pl. xciii, figs. 22, 23 ; pl. cii, figs. 4, 5.

The taking of three specimens of this rare and little-known urchin, in the vicinity of Lizard Island, is most interesting, as it was hitherto known only from the types in the M.C.Z. Of these, the holotype is from the Philippine Islands, but the two paratypes are labelled Australia, and were apparently sent to A. Agassiz by Tenison-Woods as specimens of his *Echinus darnleyensis*, as they bear the label, in Mr. Agassiz's handwriting, " *Echinus darnleyanus*. Wood. Australia." Mortensen, long ago, suggested that Woods had confused more than one species under his new name, the types of which he recorded as from Cape Grenville and Darnley Island. The present specimens thus extend the known range of the species very considerably to the south.

At St. XVII. 19 fms.. a very fine individual, 30 mm. h.d. by 15 mm. v.d., was taken, the largest specimen yet known. The abactinal system is similar to that of the type, except that the genital pores are drawn out distally as a deep furrow nearly or quite to the margin of the plate. The other two specimens, 22 × 11 mm. and 25 × 14, were taken at St. XIX, 10 fms., and resemble the type-specimens in all essential particulars. All three of the specimens have the colours brighter than in the rather dingy types ; all large spines are light dull orange, fading to nearly white at base and at tip ; the orange is more or less tinged with purple, especially distally, where some spines are distinctly violet ; small spines and pedicellariae are white : pedicels brown (dry) : test light, but grey apically, with a strong violet tinge in the largest specimen ; apical system itself, greenish-white.

Echinostrephus molare (de Blainville).

Echinus molaris, de Blainville, 1825, Dict. Sci. Nat. XXXVII, p. 88.
Echinostrephus molare, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. Harv. VII ; Rev. Ech. pt. 1, p. 119.

There are four small typical specimens, about 15 mm. in diameter, and very dark coloured, taken "6.vi.29. Yonge Reef, outer moat. Boring Sticklie & *Diadema*." This species has not hitherto been taken on the Queensland coast south of Torres Strait.

Parasalenia gratiosa. A. Agassiz.

A. Agassiz, 1863, Bull. Mus. Comp. Zoöl. Harv. I, p. 22.

This is so interesting a sea-urchin that it is desirable to give details about each of the four specimens in the present collection. Three of them have only a label, which indicates that they were collected at Low Isles. The smallest is 16 mm. long, 11 mm. wide, and about 6 mm. high ; test black or very deep brown, spines dark olive-grey, with milled rings white, as usual ; oculars all exsert ; genitals all broadly in contact with periproct ; a single tubercle is present on the inner margin of each of genitals 1, 3 and 5 ; no other tubercles on abactinal system ; periproctal plates 4, the one touching genitals 2, 3 and 4 largest. A second specimen is a trifle larger and has the same colour, but the abactinal system is very different ; there are no tubercles present, except a very small one, on the inner margin of genital 4 ; ocular II is broadly insert, and genital 3 is completely shut off from contact with the periproct by genitals 2 and 4 being broadly in contact with each other ; the periproct has 4 normal plates as usual, very nearly equal in size. The largest specimen is 26 mm. long, 20 mm. wide, and 11 mm. high. In colour it is like the other two, but again we find a characteristic abactinal system ; all oculars are exsert, and all genitals are in contact with the periproct ; on the inner margin of each genital is a single rather large tubercle ; there are *six* periproctal plates, five are subequal, triangular and form a symmetrical group around the anus ; the sixth plate is very small, pentagonal, and lies between genitals 2, 3 and 4, and two of the typical periproctal plates.

The fourth and most perplexing specimen was taken at St. XVII, 19 fms., and bears a striking superficial resemblance to a young *Echinometra*. It is 11·5 mm. long by 8·5 mm. wide, and nearly 5 mm. high ; the colour is reddish-grey, darkest on abactinal system, where the genital plates are definitely reddish ; spines pale reddish with white milled rings ; at ambitus and orally, the primaries (at least near their tip) are faintly or more or less

distinctly (especially close to peristome) banded with dusky reddish; oculars all fully exsert; genitals all in contact with periproct; no tubercles anywhere on abactinal system; periproctal plates 7, of which 5 subequal ones form a circle in contact with genital plates, while 2 smaller ones lie side by side within that circle. This little specimen might well be referred to *Parasalenia pöhlii*, but I have lost faith in the validity of that species. The resemblance to a young *Echinometra mathaei* is also striking, as already said, for young Echinometras of this size have only 3 or 4 pairs of pore-pairs in an arc, and only a few plates on the periproct. The sum total of all the characters, however, leaves no doubt that this particular specimen is a *Parasalenia*.

Echinometra mathaei (de Blainville).

Echinus mathaei, de Blainville, 1825, Dict. Sci. Nat. XXXVII, p. 94.
Echinometra mathaei, de Blainville, 1830, Dict. Sci. Nat. LX, p. 206.

Of this widely distributed and very common sea-urchin there are ten specimens, ranging from about 25 to nearly 50 mm. in length. Several are of the common reddish colour, but the majority are the more conspicuous grey, greenish or violet forms with the primary spines white-tipped. The following localities are represented: Gen. Survey; Gen. Survey, the Middle Moat, etc.; Gen. Survey, Western Moat; Yonge Reef, outer moat; the Mangrove Park; F9.

Laganum depressum, Agassiz.

Agassiz, 1841, Mon. d'Éch.: Monogr. des Scutelles, p. 110, pl. xxiii, figs. 1–7.

There are ten specimens of this common species, of which two are dead tests, with worm-tubes on them, from between Anchorage Reefs and Mangrove Park, 10.iv.29. Of the others, the largest are two tests, 60 × 50, and 67 × 55 mm.; they are bare, pale yellowish, with thick margins, especially anteriorly. Three much smaller specimens, 32–45 mm. long, light grey-brown with a yellow-green cast, were taken at St. XXIV, $16\frac{1}{2}$ fms. Dredging at Linden Bank, 28 fms., Sts. II and III, 24.xi.28, yielded three very young specimens, 18–23 mm. long, of a light silvery grey-brown colour.

Laganum dyscritum,* sp. nov.

(Plate I, figs. 5–9.)

Test distinctly pentagonal, rather thick, especially around margin, very slightly elevated at centre, but distinctly depressed proximal to margin, in the area occupied by the distal part of the petals; length, 40 mm.; greatest breadth, 38 mm., across the anterior pair of petals; about 6·5 mm. high at centre; 5 mm. thick at margin; petaloid area, 27 mm. long by 26 mm. wide. Genital pores 5. Petals rather wide, with convex sides and blunt ends which are not closed. Peristome just a trifle anterior to centre of lower surface. Periproct small, about $2\frac{1}{2}$ mm. long by rather more than 3 mm. wide; its centre is 5 mm. from the posterior end of the test. Spines numerous and long, those on the oral surface, nearly or quite 2 mm.; owing to the slenderness of the spines and their

* δύσκριτος = hard to determine.

great number, the covering of the test is remarkably like fur. Colour brown with a purplish tinge dorsally, duller and more grey orally: the spines singly are nearly white, with a faint reddish tinge.

The specimen from which the above description is taken (the holotype) is the largest of nineteen specimens from Low Isles. There are fifteen additional specimens from " off west of Low Isles, mud and gravel. 15.xi.28." ten more from " Agassiz trawling off north anchorage, Low Isles, 9 fms., 17.x.28." and a single specimen from St. IX, 12–14 fms. This last-mentioned specimen and one of those from Low Isles have a noticeable yellow-green cast to their dull brownish colouring, but they are not otherwise peculiar.

This species is closely allied to *depressum*, and I was at first inclined to consider these specimens merely a form of that species, but careful study and comparison with typical examples of *depressum* from various localities has satisfied me that it is better to recognize this Low Isles *Laganum* under a distinct name. As young specimens, and adult individuals retaining youthful characters (*i. e.* arrested variants, to adopt Jackson's very useful terminology), will probably be hard to distinguish from *depressum*, I have selected a specific name indicating that probability. Typical adult specimens of the two species are easily distinguished by several characters. Adult specimens of *depressum* have the width of the test ·80–·85 of the length, and the distance of the periproct from the margin is about ·20 of the test length; in *dyscritum* the width of the test is ·90–·95 of the length, and the distance of the periproct from the margin is about ·12 of the test length. In *depressum* the margin of the test is often not swollen and relatively is always less so that in *dyscritum*. The petals are smaller, and the petaloid area is noticeably less extensive in *depressum*. When the specimens are well preserved (and presumably, when living), *dyscritum* has the spines so long, slender and numerous, its covering is very much softer and more like a coat of fur than is that of *depressum*. Finally, I have never seen specimens of *depressum* of the dull purplish-brown colour of typical *dyscritum*, but individuals of the new species approach *depressum* in this respect.

Peronella orbicularis (Leske).

Echinodiscus orbicularis, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 144, pl. xlv, figs. 6, 7.
Peronella orbicularis, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. VII, Rev. Ech. pt. 1, p. 149.

Four young specimens of a *Peronella* were taken at the following stations: XIV, 19 fms.; XXI, 10 fms.; XXII, 13½ fms.; XXV, 20–25 fms. These specimens range from 13 × 10 to 32 × 28 mm., and were all living when collected. They show some diversity of colour, ranging from reddish-brown to a dull yellowish-green. None of them are at all " orbicular," but they are not otherwise peculiar.

Pericosmus macronesius, Koehler.

(Plate I, fig. 4.)

Koehler, 1914, Ech. Indian Mus. VIII, 1, Spatangides, p. 133, pl. xii, figs. 1–5.

The addition of this notable genus to the fauna of Australia is of exceptional interest because of its rarity, and our very imperfect knowledge of its distribution and relationships.

A single specimen was taken at St. XV, 210 fms. It is in perfect condition and answers admirably to Koehler's detailed description. It resembles his two specimens in size and proportions, measuring 61 mm. in length, 57 in width and 37 in height; the apex is 27 mm. from the anterior edge of the test, and the anterior margin of the peristome is only 10 mm. from the same point; the posterior pair of petals are 17 mm. long and the anterior pair are 22 mm.; all are 4 mm. wide; the peristome is 10 mm. wide by 5 mm. long, while the periproct is 9 mm. wide by 7 mm. high. The colour is a bright purple, but the individual spines which clothe the test quite thickly are a pale lavender when one is looked at by itself.

As Koehler's specimens lacked spines and pedicellariae, it is worthy of note that both are very abundant in the present individual. Dorsally the spines are very slender, slightly thickened at the tips, distinctly curved and more than 2 mm. long; orally they are longer and stouter and more pointed, many exceeding 5 mm. in length; at the posterior end of the test just below the marginal fasciole they form two tufts, neither conspicuous nor well-defined, yet sufficiently evident to warrant mention. The pedicellariae are found everywhere, but are particularly abundant orally. Ophicephalous pedicellariae with short wide valves, somewhat like those of *Brissopsis*, crowd the ventral ambulacra where they reach their largest size; the stalks are a millimetre long, while the valves are nearly half as much. All the rest of the pedicellariae seem to be rostrate or possibly tridentate; no sharp line can be drawn between the various forms, but the smallest are most nearly the tridentate type; the larger ones resemble the two forms figured by Koehler for *Faorina;* most of them have the valves long, very slender and strongly arched, ranging in length from less than half to more than a whole millimetre, commonly exceeding the stalk; the other form, much less common but by no means rare, has the valves much wider and stouter, especially at the tip, and about ·75–·90 mm. long. No globiferous pedicellariae were noted. On the whole the resemblance of the pedicellariae to those of *Faorina* is sufficient to warrant belief in the rather close relationship of the two genera. On the other hand, they are rather convincing proof that, as suggested when the species was first described, *Pericosmus abatoides*, H. L. Clark, is not properly congeneric with *P. macronesius*; it is probably related to *Abatus*, and will ultimately have to be made the type of a new genus.

Hypselaster fragilis (A. Agassiz and Clark).

Periaster fragilis, A. Agassiz and Clark, 1907, Bull. Mus. Comp. Zoöl. Harv. LI, p. 138.
Hypselaster fragilis, H. L. Clark, 1917, Mem. Mus. Comp. Zoöl. Harv. XLVI, p. 189, pl. cxlviii, figs. 5-8.

A small spatangoid, 22 mm. long, 18 mm. wide and 16 mm. high at the posterior apex, was dredged at St. XXI, 10 fms. It is dirty whitish with a markedly rose-reddish tinge and shows two (and only two) large genital pores. There seems to be no doubt that it is a young specimen of the species first taken by the "Challenger" in Torres Strait (unless Juke's specimen taken in 1846 at Cape York is really the same species), but first described by Agassiz and myself as *Periaster fragilis* from a young specimen taken at a depth of 391 fms. in Japanese waters. Finding the species near Lizard Island is therefore of very great interest.

Schizaster lacunosus (Linnaeus).

Echinus lacunosus, Linnaeus, 1758, Syst. Nat. ed. X, p. 665.
Schizaster lacunosus, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 168.

There are two small specimens dredged at St. XXIII, 8 fms., which call for no comment, except that they extend the known range of the species considerably to the southward.

Brissopsis luzonica (Gray).

Kleinia luzonica, Gray, 1851, Ann. Mag. Nat. Hist. (2) VII, p. 133.
Brissopsis luzonica, A. Agassiz, 1872, Illust. Cat. Mus. Comp. Zoöl. Harv. VII, Rev. Ech. pt. 1, p. 95.

A single small *Brissopsis*, 23 mm. long by 18 mm. wide, with a well-marked anal fasciole, was taken at St. VI, 114 fms., and is best referred to this widespread species, extending somewhat the southern limit of the known range.

Metalia spatagus (Linnaeus).

Echinus spatagus, Linnaeus, 1758, Syst. Nat. ed. X, p. 665.
Metalia spatagus, Lovén, 1887, Bih. svensk. Vetensk. Akad. Handl. XIII, Afd. IV, No. 5, p. 162.

Three specimens of this *Metalia* are of great interest because of their very large size, and the fact that the species has not hitherto been recorded from Australia. They have no locality labels but are supposed to be from Low Isles. The first two are about 102 mm. long, 86 mm. wide and 50 mm. high: one is a perfectly bare and bleached test, the other is nearly bare and somewhat broken, but is not bleached. The third is the largest recorded specimen yet recorded, measuring 110 × 93 × 52 mm.; it still has many spines present on the dorsal surface, and is not at all bleached.

Metalia sternalis (Lamarck).

Spatangus sternalis, Lamarck, 1816, Anim. s. Vert. III, p. 31.
Brissus sternalis, Gray, 1855, Cat. Recent Echinida, pt. 1, p. 51.

There are only two small specimens of this common species, already known from the Queensland coast. They are bare, bleached specimens labelled "*Brissus* sp., Low Id. Off Port Douglas, Queensland." They are 37 × $32\frac{1}{2}$ mm. and $49\frac{1}{2}$ × 46 mm., but even in the smaller, the confluence of the posterior petals has begun.

Maretia ovata (Leske).

Spatangus ovatus, Leske, 1778, Addit. ad Klein nat. disposit. Echin. p. 188, pl. xlix, figs. 12, 13.
Maretia ovata, Hamann, 1903, Bronn's Thierreich, II, abt. 3, p. 1397.

There are thirty specimens of this common spatangoid, ranging in size from 28 × 25 to 48 × 40 mm. Most of them are of the usual cream colour, with the petals, and often some conspicuous dorsal interradial blotches, dark brown, purplish or dusky; a few specimens show little indication of the darker shades. They are from the following places:

Off north-east of Low Isles, about 8 fms., mud bottom with stones, Sept., 1928 ; off west of Low Isles, mud and gravel, 15.xi.28 ; Sts. VIII, 11 fms. ; XIX, 10 fms. ; XXV, 20–25 fms.

Lovenia elongata (Gray).

Spatangus elongatus, Gray, 1845, Eyre, Journ. Exped. Centr. Australia, I, p. 436, pl. vi, fig. 2.
Lovenia elongata, Gray, 1851, Ann. Mag. Nat. Hist. (2), VII, p. 131.

Three small specimens all from Low Isles represent this species, already well known from Australia. One is from " north-east of Low Isles, about 8 fms. mud bottom with stones," and one is from " west of Low Isles, mud and gravel " ; these two were taken with *Maretia*. The largest specimen, not yet half grown, is 40 × 30 mm. ; it is labelled " *Breynia australiae*. Low Id." Oddly enough the common and characteristic Australian spatangoid *Breynia* is not represented in the present collection.

HOLOTHURIOIDEA.

Although the collection of holothurians contains only 159 specimens, they represent no fewer than 43 species, of 14 genera. It is undoubtedly the most interesting and important of the four echinoderm groups which I have examined, as it includes not only two new species, but five species and one genus new to Australia and three other species new to Queensland. The new species (*Thyone perforata*, *Phyllophorus trapezus*) both belong to perplexing genera, but are, I believe, very well characterized. The genus and species new to Australia (*Mesothuria parva*) belongs to one of the deep-water groups that is not characteristic of any particular geographical area, and its occurrence therefore at St. XV is not unexpected. Of the other species new to Australia, three belong to the heterogeneous assemblage still included under *Holothuria* (*H. albiventer*, *fusco-olivacea* and *pleuripus*) and the fourth is a *Pentacta* (*P. jagorii*) of uncertain status. The three species new to Queensland (*Phyllophorus holothurioides*, *Pseudocucumis intercedens Pentacta coerulea*) have all been reported in recent years from the north-western coast of Australia. Of the 43 species in the collection, 26 were taken in the immediate vicinity of the Low Isles ; 9 species were taken at St. XVII and 9 at St. XIX, both of these places being near Lizard Island.

Opheodesoma sp. ?

There are two fragments of a synaptid from St. XVII, 19 fms., very dark grey in colour with big, white patches made up of spicules. These show that the specimen is an *Opheodesoma*, but as the head end is wanting, it would be unwise, if not impossible, to assign it to any particular species ; it is quite probably *grisea*.

Polyplectana kefersteinii (Selenka).

Synapta kefersteinii, Selenka, 1867, Z. wiss. Zool. XVII, p. 360, pl. xx, figs. 120–121.
Polyplectana kefersteinii, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, pp. 16, 22, 77, pl. iv, figs. 20–22.

A couple of fragments without a head and in poor condition seem to represent this species. There is no locality label save " Probably from Low Isles."

Synapta maculata (Chamisso and Eysenhardt).

Holothuria maculata, Chamisso and Eysenhardt, 1821, Nov. Acta Leop. Carol. X, pt. 2, p. 352.
Synapta maculata, Jäger, 1833, De Holothuriis, p. 15.

There are two typical specimens of this well-known form, each with 15 tentacles; one, 425 mm. long and 30 mm. in diameter, is labelled simply " Low Isles "; the other, 900 mm. long, but only 15–20 mm. in diameter, is labelled " G.B.R.E.

Synaptula recta (Semper).

Synapta recta, Semper 1868, Reisen im Archipel. der Philippinen. I, Holothurien, p. 14.
Synaptula recta, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, p. 84.

This species is represented by two specimens, neither of which is, however, typical. One is a light-coloured individual bearing the label " Mangrove Park, 17.iv.29," which has the calcareous particles and other features of *recta*, but possesses 15 equal tentacles; it is 70 mm. long and about 4 mm. in diameter: the tentacles are notably long, 7 mm., and the colour is uniformly pale brown; it seems better to consider this specimen a somewhat aberrant *recta*, than make it the type of a new species: I cannot consider it as either *reciprocans* or *rosea*, the only 15-tentacled species in the genus. The other specimen is about the same size, but of a darker colour, and is in two wretched fragments; there are apparently 12 tentacles, but it is hard to decide whether they are equal or not. This individual was dredged at St. XIII, 16½ fms.

Polycheira rufescens (Brandt).

Chirodota rufescens, Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 259. [Reprinted as Prodr. Descr. Anim. p. 59.]
Polycheira rufescens, H. L. Clark, 1908, Smithson. Contr. Knowl. XXXV, Apodous Holothurians, p. 120.

There are 15 specimens of this holothurian in the collection, but they call for little comment, except that the occurrence at Low Isles is a considerable southern extension of the known range. Most of these individuals are small, the largest measuring 95 mm. in length and 15 in diameter. They are of different shades of brown, and show great diversity in the number of wheel papillae. They were collected at the following places: Snapper Island, Gen. Survey, 7.iii.29; Gen. Survey, Inner Rampart, 20.iii.29; RD and R16, 22.iii.29; Tripneustes Spit, 21.iii.29.

Thyone papuensis, Théel.

Thyone fusus, var. *papuensis*, Théel, 1886, Voy. "Challenger," XIV, pt. 39, Holothurioidea, 2, p. 92, pl. viii, fig. 1.
Thyone papuensis, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 167.

There are three Thyones which I am referring to this species, but my study of them has led me to the conviction that the group of species related to *fusus*, as shown by the calcareous particles, is sadly in need of revision. The specimens at hand are as follows: St. XIX, 10 fms., a small individual, less than 20 mm. long, but 7 mm. in diameter,

with very numerous pedicels ventrally, but dorsally with few pedicels, 15–20 of which are situated on wart-like elevations, which might be called papillae; these papillae form a series on each side of the dorsal surface, and tend to give the body a more or less quadrangular form. The calcareous ring and particles in the body-wall correspond well with Théel's description of what he found in *papuensis*. From "off north of east, Low Isles, 19.x.28, Agassiz trawling, 12 fms., mud," there is a specimen, about 60 mm. by 25, with tentacles well expanded but in poor condition, which shows no marked difference between the dorsal and ventral surfaces, though the pedicels are perhaps fewer and larger dorsally; the calcareous ring and particles answer almost perfectly to Théel's figures and description. The third specimen is, like the smallest, from St. XIX, 10 fms., but is very large, nearly 100 mm. long (not including the tentacles) and 25 mm. in diameter; the tentacles are notably big, the dorsal ones over 30 mm. long when fully extended; there is no marked difference between the dorsal and ventral surfaces and no indication that the body was ever quadrangular; the calcareous ring is very heavy and the posterior prolongations of the radial pieces are much shorter than in the smaller specimens, where they exceed the height of the ring itself. The calcareous particles in the body-wall are not distinguishable from those of the smaller specimens.

It seems to me, from the evidence of these three specimens, that Ludwig's *mirabilis* is identical with Théel's *papuensis*, and that both are very near *fusus*. But, as Dr. Deichmann called to my attention, the pedicels in the Australian species are noticeably larger than in the European and lack the curved supporting rod-tables so common in *fusus*. I think Semper's *villosus* from the Philippines may be identical with the Australian form, and several other forms described from the East Indian region also have tables more or less like those of *fusus*. Until I have examined more material I propose to let the Low Isles *Thyone* bear the name suggested by Théel, but it probably should be called *mirabilis* Ludwig, as that name is earlier than Théel's.

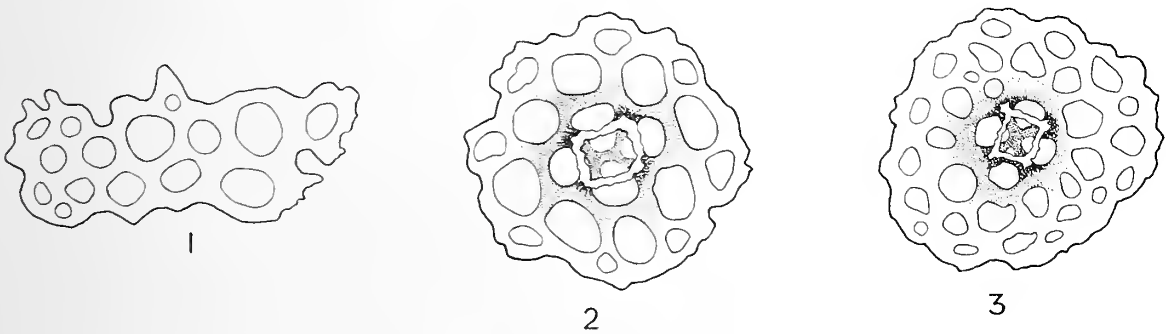
Thyone perforata,* sp. nov.

Length from mouth to anus along the somewhat concave back about 13 mm., but along the convex ventral side it is more than 20 mm.; diameter about 7 mm.; body nearly cylindrical at middle. Tentacles strongly contracted, apparently 9, with one smaller than the others; probably 10, with two small ones as usual in *Thyone*. Pedicels numerous all over the body, but distinctly less numerous on dorsal side. Anal teeth present, or, at least, anal papillae markedly calcified. Calcareous ring relatively large and stout; radial pieces 2 mm. high, of which about ·75 mm. consists of posterior prolongations; interradial pieces 1 mm. high, of which about one-third is the acute anterior point, and nearly 1 mm. wide; neither radial nor interradial pieces have the appearance of being made up of smaller pieces, as is so often the case in *Thyone*. Polian vessel single, rather conspicuous. Madreporic canal single, slender.

Calcareous particles, tables and perforated plates. Tables of two kinds, but both are characterized by large discs with many perforations, and a more or less complete spire; in one kind (Text-fig. 2), which I believe are youthful and would probably be lacking in adult specimens, the perforations are regularly arranged, four at the centre, then a circle

* The name is selected because of the large number of perforations in the disks of the tables.

of eight very large ones and then eight much smaller ones; this outer circle is usually incomplete and often wanting: in the mature tables (Text-fig. 3) the four central perforations are present, but smaller than in the youthful ones, while distal to them are many perforations of diverse sizes, but generally small, and quite irregularly arranged. In both sorts of tables the spire is commonly incomplete; it may consist merely of four vertica pointed rods, one arising from each of the bars which separate the four central perforations; these rods are, however, commonly united with each other by a single, median bar, forked at each end, giving a point of contact with each vertical rod; generally the vertical rods extend considerably above the connecting bar, and at the upper end send out two horizontal projections, at right angles to each other, growing out towards the corresponding projections of the neighbouring rods; these horizontal projections ultimately meet their fellows and fuse with them, forming a quadrilateral top to the spire; when complete this top carries several small and irregularly projecting teeth, usually at the corners. Very



Thyone perforata, sp. nov.

Text-fig. 1.—Perforated plate from dorsal body-wall.
Text-fig. 2.—Youthful table.
Text-fig. 3.—Mature table. All figures × 445.

few tables have a complete spire, but probably in an adult individual the tables would be more generally complete. When fully developed, the height of the spire is rather more than half the diameter of the disc. The perforated plates (Text-fig. 1) are of diverse sizes and shapes, but are usually longer than wide; they may be constricted at the middle or they may be widest at that point. Neither terminal plates nor supporting rods have been detected in the pedicels, beyond question, but I believe terminal plates are present. The tables seem to be most abundant ventrally and scarce or wanting dorsally; the perforated plates, on the other hand, are scarce ventrally and more common, but by no means abundant dorsally; nowhere are the calcareous particles sufficiently common to overlap one another; they are usually well spaced in the body-wall, even ventrally.

Colour of specimen light grey; tentacles dark brown. The unique holotype of this noteworthy species was taken at St. XII in "Penguin Channel, 10–15½ fms., rock and shell gravel, mud on edges of pit." So far as I can see this interesting *Thyone* is quite unlike any species as yet described, the characteristic tables setting it apart very distinctly from all the known species of the genus, and I do not think there can be any doubt that it is a *Thyone*.

Thyone sacellus (Selenka).

Stolus sacellus, Selenka, 1867, Z. wiss. Zool. XVII, p. 355, pl. xx, figs. 115, 116.
Thyone sacella, von Marenzeller, 1882, Verh. Zool.-Bot. Ges. Wien, XXXI, p. 134.

A specimen from St. X, 14–17 fms., seems to be of this species. It is 40 × 10 mm. and bright brown in colour. The pedicels are few, especially on the back.

Phyllophorus holothurioides, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 96.

Two small holothurians undoubtedly belong to this species, which has previously been reported from the East Indies and north-western Australia; thus addition is made to the fauna of the Queensland coast. Like Ekman's specimen from north-western Australia, these individuals are very small, only about one-third as large as Ludwig's type. One is 25 × 13 mm., strongly contracted and dark grey in colour; the pedicels are rather numerous and irregularly scattered, except at the ends of the body, where they are confined to a double series in each ambulacrum, most evident posteriorly; the calcareous particles and ring are like Ekman's figures; this specimen was dredged at St. XIX, 10 fms. The other individual, 25 × 9 mm., was taken at St. XVII, 19 fms., is of a light brown colour and the pedicels are apparently confined to the ambulacra; the calcareous ring and particles are similar to those of the specimen from St. XIX; the tentacles appear to be quite definitely arranged in an outer circle of five pairs of rather large tentacles and an inner circle of five pairs of much smaller tentacles alternating with them.

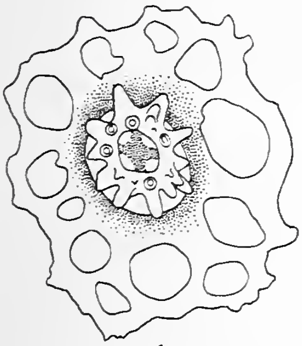
Phyllophorus trapezus,* sp. nov.

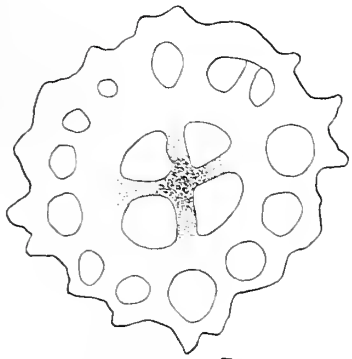
Length from tip of expanded tentacles to anus, along the concave dorsal side, 37 mm.; along the convex ventral surface, 57 mm.; diameter about 8 mm.; body nearly cylindrical at middle, but tapering towards each end, especially posteriorly. Tentacles 20, fully expanded, 5 pairs of large ones (about 7 mm. long) alternating with 5 pairs of small ones (about 2 mm. long). Pedicels numerous all over the body, but both anteriorly and posteriorly they form a distinct double series in each ambulacrum, with none on the interambulacra between; this is, however, for a distance of only 2–3 mm.; at the middle of the body the terminal discs of the pedicels are about 0·4 mm. in diameter. Calcareous ring (Text-fig. 9) relatively high and stout (about 5 mm. high, with posterior prolongations of radial pieces about 7 mm. more); radial pieces square cut at anterior end, very deeply forked posteriorly, each posterior prolongation being made up of several pieces; a deep longitudinal furrow on the outer surface nearly divides the anterior part of the plate into two narrow pieces; interradial pieces long, narrow, very acute anteriorly, truncate posteriorly; posterior half made up of 5–7 pieces. Polian vessel single of moderate size. Madreporic canal not detected.

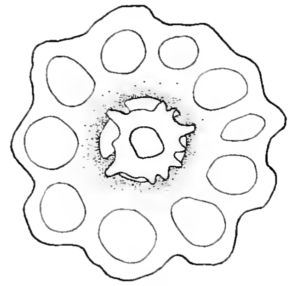
Calcareous particles, tables, perforated plates and miliary granular plates. The granular plates (Text-fig. 8) are found only in the introvert, so far as known, and are not

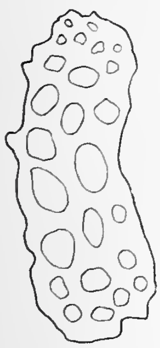
* This name is selected because of the characteristic tables in the skin.

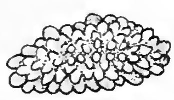
abundant there; they may be circular, oval or elliptical in form, but are noticeably convex, at least on the outer surface. The perforated plates (Text-fig. 7) are found only at the tips of the pedicels close to the terminal plates, which are large and circular. The tables are found well distributed over the body surface, but are nowhere abundant; the disk is circular (Text-fig. 5) or more or less quadrangular (Text-fig. 4), with the margin


4


5


6


7


8


9

Phyllophorus trapezus, sp. nov.

TEXT-FIG. 4.—Table with base more or less quadrilateral, from holotype.
TEXT-FIG. 5.—Table with more circular base, seen from below, from holotype.
TEXT-FIG. 6.—Table from one of the paratypes.
TEXT-FIG. 7.—Supporting plate from pedicel.
TEXT-FIG. 8.—Miliary granule from introvert of holotype.
TEXT-FIG. 9.—A piece of the calcareous ring, × 2.
Text-figs. 4–8 × c. 450.

undulate or more or less rough, with projecting teeth, which are usually blunt or rounded at tip; there is a large perforation at centre, and around this is a circle of about 10 nearly circular perforations of considerable size (Text-fig. 6), usually with a number of smaller holes irregularly placed distal to them. The spire is about as tall as the diameter of the disk, is well developed, and crowned with a complete circular or square summit, open at the centre, and bearing a number of projecting blunt spines, as shown in Text-figs. 4 and 6.

Colour of holotype light yellowish brown, with tentacles a pale brown; one of the

paratypes is a similar yellow brown, but the others are considerably darker, in part at least because they are much more contracted.

The holotype was taken at Low Isles. The 6 paratypes, of which the largest is 35 mm. long and 15 mm. in diameter, were dredged $\frac{1}{4}$ mile south of Cape Kimberley in 4 fms. on a bottom of shell and gravel, 2nd December, 1928.

The paratypes are all much contracted, but the calcareous particles are so similar to those of the holotype, I feel sure of their identity. In one of the smaller ones the tables are nearly all as shown in Text-fig. 6 ; I believe these are more youthful tables than the majority of those found in the holotype ; in all of the specimens some of the tables are of the youthful type. There is no doubt that this species of *Phyllophorus* is nearly related to *cebuensis* (Semper) and *fragilis*, Ohshima, but it is easily distinguished from the former by the calcareous ring and from the latter by the tables. Unfortunately our knowledge of *cebuensis* is very incomplete, as no description of the calcareous particles has ever been published and Semper's single figure is very inadequate. Ohshima's description and figures of *fragilis* are very satisfactory, and the resemblance between *fragilis* and *trapezus* in general appearance and in the calcareous ring is striking, but the tables in the Japanese species have a low and usually incomplete spire, so I do not think the Australian specimens may be properly referred to it. Of course, abundance of material from the East Indian region may show sufficient diversity to prove that *cebuensis*, *fragilis* and *trapezus* are really but a single species.

Pseudocucumis africanus (Semper).

Cucumaria africana, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 53, pl. xv, fig. 16.
Pseudocucumis africana, Ludwig, 1888, Zool. Jahrb. Syst. III, p. 815.

This little holothurian, easily recognized by its very characteristic calcareous plates, is represented in the present collection by three specimens, 30–35 mm. long, from Low Isles, labelled " *Holothuria* (*atra ?*) " ; eleven specimens, 18–40 mm. long, from Low Isles, labelled " Only under coral blocks, juv." ; one specimen, 18 mm. long, from Three Isles, 5th May, 1929.

Pseudocucumis intercedens, Lampert.

Lampert, 1885, Semper, Reisen im Archipel der Philippinen. IV, Abt. 3, Die Seewalzen, p. 254, fig. 54A.

The holotype of this species was from an unknown locality, but in 1886 Ludwig recorded a specimen from Amoy, China. It was not reported again until 1918, when Ekman discussed three individuals, one quite immature, from the north-western coast of Australia. It is therefore of much interest to find three specimens in the present collection ; the largest, 36 mm. long, is a typical specimen from St. XVII, 19 fms. ; a second, only 20 mm. long, much contracted, but typical, is from St. XVI 20 fms. ; the third, from St. IX, 12–14 fms., although 30 mm. long, has a very thin body-wall with small tables, such as Ekman describes as found in a juvenal specimen examined by him. There is some ground for believing that *P. eurystichus*, H. L. C., from Friday Island, Torres Strait, is really identical with *intercedens*, but a re-examination of the holotype of that species leaves me in doubt. The Torres Strait specimen has more pedicels

and wider ambulacra, and the calcareous ring is heavier and has distinct posterior prolongations on the radial pieces, though these are somewhat exaggerated in my original figure. These differences may prove to be due to age, but for the present the two species may be permitted to stand. There is no important difference in the calcareous particles, the tables being essentially alike in the two forms.

Actinocucumis typica. Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 91.

At St. XIX, 10 fms., a very fine specimen of this species was taken. It is 125 mm. long by 20 mm. in diameter and bright brown in colour. The body-wall is notably firm, though not particularly thick.

Pentacta coerulea (Semper).

Colochirus coeruleus, Semper, 1868, Reisen im Archipel der Philippinen. I Holothurien, p. 59, pl. xi, fig. 1; pl. xiii, fig. 18; pl. xiv, figs. 1, 14; pl. xv, fig. 1.
= *Colochirus quadrangularis*, auct. mult. since 1846.

For many years this holothurian has borne the name *quadrangularis* (Lesson), but Ekman (1918) has pointed out that Lesson's species was an aspidochirote and his name ought not to be used for a dendrochirote form. As I fully agree with this conclusion, I am adopting Semper's name, which is accompanied in its original publication with an adequate description and beautiful figures. Lesson's *Holothuria quadrangularis* is probably a *Stichopus*, and the figure and description would do fairly well for *chloronotus* (Brandt) except for colour. As the type locality is a bay on Waigeou, a place rarely visited by zoologist or collector, it is not impossible that *quadrangularis* is a valid species.

In the present collection are five specimens representing *Pentacta coerulea*: A small specimen, 65 × 22 mm., dredged at St. XII, 10–15½ fms., a very young one, only 19 × 6 mm., at St. XIV, 19 fms., and three very dark coloured individuals (the largest 110 × 35 mm.) at St. XIX, 10 fms. The species has not been recorded hitherto from the Queensland coast.

Pentacta cucumis (Semper).

Colochirus cucumis, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 58, pl. xiii, fig. 17; pl. xiv, fig. 16.
Pentacta cucumis, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. **X**, p. 171.

I am referring to this species a small holothurian, 25 × 11 mm. in its contracted condition, which was taken at St. XVI, 19 fms. It is probably young, but the calcareous particles warrant referring it to Semper's species. It must be said, however, that there is no genus of holothurians in which the species are more confused than in *Pentacta*, and one may not hope to be sure of the identity of any small specimens, until the group has been carefully revised.

Pentacta jagorii (Semper).

Colochirus jagorii, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 60.

A small *Pentacta* from St. XVII, 19 fms., has been the source of much perplexity. Both Dr. Deichmann and I were inclined to regard it as a specimen of *P. australis*, Ludwig, which we do not consider a synonym of *doliolum*, Pallas. But the more critically it has been studied, the more difficult it has been to identify it with Ludwig's species, and I was about to set it down as an undescribed form, when my attention was directed to Semper's *Colochirus jagorii* from Singapore. The original description is very brief, and not accompanied by any figures ; so far as I know, no further information regarding *jagorii* has been published, but Théel (1886) expressed the opinion that it may be identical with *quadrangularis*, Lesson. This does not seem to me probable.

The *Pentacta* before me, which I am referring to *jagorii*, agrees very well with Semper's description of that species, and it seems better to me to refer it to *jagorii* than to describe it as new. But a full description of the present specimen is here given so that in the future, when material from Singapore is available, it may be possible to determine whether the Australian form really is identical therewith. The individual from St. XVII is markedly quadrangular, becoming pentagonal anteriorly and rounded pentagonal at the posterior end. It is 42 mm. long, 8 mm. wide and 7 mm. high, 10 mm. from the anterior end, and 5 mm. wide and 4 mm. high close to the posterior end. Body-wall thick and hard, more or less rigid, from the abundance of calcareous plates and particles which it contains. Mouth terminal, not wholly closed by the five equal well-developed, triangular oral valves ; these valves terminate the radii of course, and each bears 2 or 3 papillae (like those of the ambulacra, but smaller) and several small tubercles. Dorsal ambulacra each with a single series of 7 or 8 large, irregularly spaced papillae, about 2 mm. high by 1 in diameter ; these papillae are truncate, and have a distinctly pedicel-like tip, with a terminal plate. Each lateral ambulacrum has a series of about a dozen similar papillae, somewhat smaller, more retractile and more like pedicels ; this series is on the dorsal margin of the ambulacrum, and ventral to it are two or more crowded series of pedicels, which are fully retracted. Midventral ambulacrum with a double series of large pedicels, which are strongly retracted ; it is uncertain whether there are additional pedicels on each side still more retracted ; both anteriorly and posteriorly this ventral band of pedicels is replaced by large papillae like those of the dorsal radii, anteriorly there are two such, one in front of the other ; posteriorly there are two, placed side by side. Besides the papillae and pedicels of the ambulacra, there seem to have been much smaller pedicels scattered all over the interambulacra ; owing to the strongly contracted condition of the appendages, however, it is uncertain whether these are really indications of pedicels, or merely pits in the outer layer of the body-wall. Anus surrounded by overlapping scales, which are well developed, but are distinctly seen only when the animal is partly dried ; they could hardly be called distinct "teeth."

Tentacles 10, the 2 ventral much smaller than the others, which are only moderately retractile owing to the large amount of calcareous material which they contain in the form of densely crowded perforated supporting rods. Calcareous ring simple and not peculiar ; there are no posterior prolongations, but each piece is concave posteriorly and has a long anterior projection ; the projections of the radial pieces to which the retractor muscles

are attached are wider and blunter than those of the interradial pieces. There is a single rather large Polian vessel and two moderately developed clusters of genital tubes. Not more than a single stone canal is present.

Calcareous particles of the body-wall excessively numerous. The innermost layer is made up, as usual in *Pentacta*, of large, irregular, unequal plates or scales, many of which are a millimeter or more across. External to this is a thin but crowded layer of perforated plates and ellipses, no two of which are exactly alike: the fundamental form of these plates, which are rather delicate in structure, has four large perforations, ten or more marginal projections, and about ten small knobs on the outer (upper) surface; the number of perforations is generally more than four, and there is a tendency for projections and arches to grow up, meet and transform the plate into a perforated ellipse, which, however, is provided with numerous knobs and projections; on the other hand, many of the plates are more or less imperfectly developed. It is useless to give figures of these plates, so great is their diversity of detail; many of them are almost exactly like those found in *Pentacta minuta* and other species of the genus. Large, thick, knobbed buttons or plates, such as are characteristic of *australis* and *minuta*, seem to be quite lacking. The outermost layer of the body-wall is made up of somewhat compressed "baskets" or reticulate hemispheres, as deep as they are wide, with smooth outer surface and only a few rather coarse, marginal teeth. Supporting rods of pedicels in the form of narrow perforated plates; those of the tentacles, curved or bent rods, perforated at the ends and often at the middle also. Colour greyish white, with a brownish tinge on back and sides; terminal branches of tentacles dark brown.

A comparison of the above description with the brief diagnosis of *jagorii* given by Semper shows some points of difference which call for comment. Semper's specimen was considerably stouter, the dorsal papillae were bigger, and the pedicels in the ventral ambulacra much more numerous, but such differences might easily be due to age and degree of contraction. It is uncertain whether *jagorii* has the large papillae along the latero-ventral margins, but it may be inferred that they were present, since Semper calls especial attention to the presence of such papillae anteriorly and posteriorly on the ventral surface; it is quite unlikely these would be present if the lateral ones were absent. There is little significance in the absence of the "numerous, small" stone-canals on the circumoral water-ring to which Semper refers; this might be a matter of age or condition. Of course if such a difference were found to be constant, it would be of great interest and importance.

Pentacta minuta (Ludwig).

Colochirus minutus, Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 89.

Two small specimens of *Pentacta*, quite unlike in external appearance, but identical in their calcareous deposits, are best referred to this species, which is still very imperfectly known. The type locality is Bowen, Queensland. The smaller specimen is 28 mm. long, and 4 mm. in diameter; the form is distinctly quadrangular, but the body-wall is thin and not very rigid; the dorsal ambulacra bear a few fully retracted pedicels (or papillae ?) and are not clearly indicated; each of the three ventral ambulacra is marked by a double series of large pedicels; the ten tentacles are well expanded, the two ventral conspicuously smaller than the others; colour of both body and tentacles light brown.

This individual was dredged at St. XVI, 20 fms. The larger specimen was taken at St. IX, 12–14 fms., and has a very different appearance. The colour is nearly white, the tentacles are fully retracted, and the hard body is sharply quadrangular. The dorsal ambulacra bear small pedicels, many of which are on papillae of irregular size and appearance, each series forming a dorso-lateral angle of the body; the ventro-lateral angles are formed by a similar series, immediately below which is an imperfect double series of large pedicels; the midventral ambulacrum is indicated by a somewhat irregular series of large pedicels, double at each end, but at least four pedicels wide at the middle; many ventral pedicels are imperfectly or little contracted, owing apparently to the numerous calcareous rods and plates in the walls. This specimen is over 40 mm. long, 8 mm. wide and 7 mm. high.

In both specimens the calcareous particles correspond so well with the descriptions and figures given by Théel (1886) and Erwe (1913) that I do not see any differences worth noting. As in all Pentactas, there is the greatest diversity in the individual particles of any particular kind, but it would be futile to try to describe or figure all of these. It is still uncertain whether the differences between *minuta* and *australis* are really specific or whether they are merely a matter of age.

Pentacta tuberculosa (Quoy and Gaimard).

Holothuria tuberculosa, Quoy and Gaimard, 1833, Voy. "Astrolabe," IV, p. 131.
Pentacta tuberculosus, H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 171.

Ten strongly contracted specimens, showing no indication of the living colour or form, represent this common species, which ranges from southern Japan to Port Jackson, N.S.W. None of these specimens is full grown and none call for comment; seven were taken at St. XIX, 10 fms., and one each at St. XIV, 19 fms., St. XVII, 19 fms., and in 12 fms., on muddy bottom, north of east of Low Isles, 16.x.28.

Mesothuria parva, Théel.

Mesothuria murrayi, var. *parva*, Théel, 1886, Voy. "Challenger," Zool. XIV, Holothurioidea, pt. 2, p. 186, pl. ix, fig. 2; pl. xvi, figs. 4, 5.
Mesothuria parva, Fisher, 1907, Proc. U.S. Nat. Mus. XXXII, p. 686, pl. lxxi, figs. 2A–C.

At St. XV, 210 fms., three specimens of this species were taken. They measure in their present condition 55 × 13 mm., 90 × 20 mm. and 150 × 30 mm. They are pale grey, with the tentacles darker. The bare ventral area is least evident in the smallest and most conspicuous in the largest specimen. The calcareous particles are similar in the three specimens, and agree well with Fisher's description and figures. He is, I believe, quite right in considering *parva* a species distinct from *murrayi*. The genus has not hitherto been recorded from Australian seas.

Holothuria albiventer, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 83, pl. xxx, fig. 14; pl. xxxv, fig. 5.

There are two strongly contrasted individuals from St. XVII, 19 fms., which seem to represent this East Indian species not hitherto known from Australia. They

are each about 35 × 18 mm.. and show no marked contrast in colour between the upper and lower surfaces. A third specimen, 55 × 20 mm., from St. XII. 10–15½ fms., is not quite so strongly contracted, and the ventral surface is conspicuously lighter than the dorsal. The calcareous particles, especially the tables, are somewhat different from those of the other specimens, but these differences do not seem to be significant.

Holothuria arenicola, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien. p. 81, pl. xx; pl. xxx, fig. 13; pl. xxxv, fig. 4.

This common and widespread species is represented by three specimens, of which two, from General Survey I, are strongly contracted, and yet are 180–190 mm. long by 20 mm. in diameter; they are strongly tinged with rust-colour—such a frequent characteristic of the species. The third specimen, labelled only Low Isles, is smaller (150 × 30 mm.) and not at all rusty, but the characteristic dark blotches of the dorsal side are well marked.

Holothuria atra, Jaeger.

Jaeger, 1833, De Holothuriis, p. 22.

This common species is represented by 8 specimens: 1 from Low Isles; 2 small ones also from Low Isles; 2 large ones (150 × 50 mm.), very black, "killed in fresh water, sand flats, covered with a sand film, 7.ix.28"; and 3 specimens, 80–150 mm. long, from "Low Island, off Port Douglas, Queensland."

Holothuria coluber, Semper.

Semper, 1868, Reisen im Archipel der Philippinen, I, Holothurien, p. 90, pl. xxviii; pl. xxx, fig. 28.

A single, average specimen is in the collection from "Gen. Survey 1M1."

Holothuria curiosa, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 110.

This species, originally described from Bowen, Queensland, is represented by a single small (75 × 17 mm.) but typical specimen from Low Isles. The general colour is brownish grey, but the periproctal area is very dark in striking contrast; dark rings at the base of the papillae are present, but are not conspicuous; they were a marked feature of Théel's specimen from Fiji, which was 180 mm. long.

Holothuria edulis, Lesson.

Lesson, 1830, Cent. Zool. p. 125.

There are two very typical specimens of this common species; the smaller, 150 mm. long by 25 mm. thick, dark slate grey above, light grey below, has no locality label; the larger (175 × 37 mm.), from Linden Bank, St. V, 29.xi.28, has the upper surface and the

middle of the oral surface dusky, the remainder of the oral surface dirty cream colour. In life the species is quite handsome, the upper surface brown and the lower bright rose-colour, but alcohol completely destroys the beauty.

Holothuria erinaceus, Semper.

Semper, 1878, Reisen im Archipel der Philippinen. I, Holothurien, p. 91, pl. xxx, figs. 23, 24.

This species is represented by a single small specimen, 30 × 12 mm., from Gen. survey, 6d, 22.iii.29. It has been recorded from Port Mackay, Queensland.

Holothuria fusco-olivacea, Fisher.

Fisher, 1907, Proc. U.S. Nat. Mus. XXXII, p. 672, pl. lxix, figs. 3, 3*a–f*; pl. lxx, fig. 3.

Although this species has hitherto been known only from the Hawaiian Islands, I venture to refer to it a holothurian, 60 × 15 mm., from Low Isles. It answers so well to Fisher's description and figures, and the calcareous particles are so characteristic that I feel no doubt as to the identity. But there are no light rings around the dorsal papillae, so far as I can see, and I found none of the "very large tables," of which Fisher says they are "few." I am inclined to think it possible that these large tables do not really belong to this species, but came from a specimen of *Stichopus tropicalis*. Everyone who has worked with holothurian material knows how easy it is for spicules from one species to appear in preparations from a totally different form. Where any form of spicule is notably infrequent, suspicion as to its normal presence may well be aroused.

Holothuria hypamma, H. L. Clark.

H. L. Clark, 1921, Pap. Dept. Mar. Biol. Carn. Instn. X, p. 177, pl. xxxviii, figs. 20–24.

There is a single typical specimen, 50 mm. long, 20 mm. wide and 10 mm. thick, from Low Isles.

Holothuria impatiens (Forskål).

Fistularia impatiens Forskål, 1775, Descr. Anim. p. 121.
Holothuria impatiens Gmelin, 1788, Linn. Syst. Nat. ed. XIII, I, pt. 6, p. 3142.

There are sixteen specimens of this widespread, puzzling holothurian, which show such diversity of form and colour, it is hard to admit that they represent only a single species. They range from 35 to 200 mm. in length, with the large ones fully 30 mm. in diameter. The colour ranges from the uniform purplish-grey of "variety *concolor*" to a rich red brown. Several specimens have the papillae yellow in marked contrast to the purplish-grey body-wall. One small specimen is almost whitish with dark spots dorsally. As Fisher pointed out, the papillae have the tips quite like pedicels, with well-formed terminal plates. Several of the specimens have no label, and others are marked as from Low Isles only, but the following definite localities are given: Tripneustes Spit, 21.iii.29; extra collection E. A. F., RA. On the whole the calcareous particles of this species are quite distinctive and easily recognized. It seems to be true, however, that large

specimens have the tables larger, with several or sometimes many small perforations peripheral to the usual nine holes in the disk, and the top of the spire crowded with numerous teeth. But I can find no satisfactory characters by which *botellus*, Selenka, as figured by Semper, can be separated from *impatiens*, even though I feel strongly inclined to doubt their identity.

Holothuria leucospilota (Brandt).

Stichopus (Gymnochirota) leucospilota Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 251. [Reprinted as Prodr. descr. Anim. p. 51.]
Holothuria leucospilota, Ludwig, 1881, Z. wiss. Zool. XXXV, p. 595.

There are nine small specimens, under 100 mm. long, from the following localities: Low Isles: Three Isles, 5.v.29; Three Isles, 8.iii.29. The species is so well known, these specimens call for no comment.

Holothuria marmorata (Jaeger).

Bohadschia marmorata, Jaeger, 1833, De Holothuriis, p. 18.
Holothuria marmorata, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 79, pl. xxx, fig. 10; pl. xxxv, fig. 3.

There are two small, much-contracted specimens from Low Isles, one with the label 1M1.

Holothuria martensii, Semper.

Semper, 1868, Reisen im Archipel der Philippinen, I, Holothurien, p. 86, pl. xxx, fig. 16.

There are two fine examples of this notable species, taken in the vicinity of Lizard Island; one, 70 mm. long, 29 mm. wide and only 16 mm. high, was dredged at St. XXII, $13\frac{1}{2}$ fms.; the other, $80 \times 28 \times 24$ mm., was dredged at St. XXIII, 8 fms. In the smaller specimen the ventral papillae are very white. Study of this material satisfies me that *Holothuria subverta*, H. L. Clark, from the Murray Islands, is based on a specimen of this remarkable form.

Holothuria monacaria, Lesson.

Lesson, 1830, Cent. Zool. p. 225.

It is curious that this species, common at the Murray Islands and also found at Green Island near Cairns, should be represented in the present collection by only a single, poor, small specimen, labelled simply Low Isles.

Holothuria notabilis, Ludwig.

Ludwig, 1875, Arb. Zool. Inst. Würzburg, II, p. 102.

After much hesitation I have decided to refer to this species, originally described from Bowen, Queensland, two holothurians, one from 4 fms. $\frac{1}{4}$ mile south of Cape Kimberley, the other from Low Isles. The former is much contracted, about 50 mm. long by

17 mm. in diameter; the latter is in much better condition, about 80 × 20 mm. Both are deep brown above, lighter ventrally, with numerous whitish spots, in each of which is a pedicel; on the dorsal side is a double series of blackish blotches, which are rather faintly indicated, particularly in the larger specimen. The calcareous particles are quite distinctive and correspond fairly well with Ludwig's description (his figures are inadequate), but a large proportion of the buttons have more than three pairs of holes; Ludwig does not refer to the number of holes, merely saying the buttons are small. The tables range from perfectly-formed ones, with a disk having the margin spiny and a normal spire terminating in a nearly circular, ring-like top carrying a few teeth, to more or less aborted ones, the extreme form having no spire, being thus reduced to small concave plates with a few marginal spines and several irregular perforations, like Ludwig's figures. The calcareous ring is moderately stout, but the radial plates are not at all like Ludwig's figure, as they are wide, do not project posteriorly, and have that margin strongly concave. As already noted, the colour corresponds only imperfectly to Ludwig's description; he makes no mention of the numerous nearly whitish spots, which are so conspicuous in the present specimens. The internal organs of these specimens are in poor condition, but apparently Cuvier's organs were present. On the whole, it seems to me better to consider these individuals as *notabilis* rather than to describe them as a new species; the similarity in the calcareous particles is too marked.

Holothuria ocellata (Jaeger).

Bohadschia ocellata, Jaeger, 1833, De Holothuriis, p. 19.
Holothuria ocellata, Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 80.

A very fine typical specimen of this handsome species was dredged at St. XXI, 10 fms. It is 150 mm. long, 45 mm. wide and only 30 mm. high; the lateral margins are pronounced. In preparing my list of the echinoderms of Torres Strait (1921), this species was carelessly overlooked. It is closely related to *martensii*; the two should be separated generically from typical *Holothuria*. The description and figures given by Théel (1886) of the Challenger specimen from Torres Strait is what warrants referring the present specimen to Jaeger's species.

Holothuria pardalis, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 336, pl. xix, fig. 85.

There are four specimens of this common species, but all are small and much contracted. One has no locality label, and one is labelled "Gen. Survey, RD and R16, 22.iii.1929." The other specimens are notable for the very numerous heaps of calcareous "buttons."

Holothuria pervicax, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 327, pl. xviii, fig. 54.

The single specimen of this species is about 175 mm. long and was dredged at St. XIV, 19 fms. The colour is uniformly dark with no dorsal blotches, but the spicules,

calcareous ring and internal anatomy are typical. There is a label reading : " Holothurian from which *Fierasfer* was obtained."

Holothuria pleuripus (Haacke).

Cystipus pleuripus, Haacke in Möbius, 1880, Beiträge zur Meeresf. der Insel Mauritius, p. 47.
Holothuria pleuripus, Ludwig. 1883, Ber. Oberhess. Ges. Nat-. u. Heilk. XXII, p. 174.

A little, flat holothurian. 16 mm. long, 9 mm. wide and only 4 mm. high, of a nearly white colour, was collected at Low Isles. There are large papillae dorsally, and numerous pedicels in approximately three series on the ventral side. The calcareous spicules are very characteristic, and seem to me more like those of this species than they are like those of *bowensis* Ludwig, the closely related species described from a single specimen, 45 mm. long, from Bowen, Queensland. It is possible that the two species will prove to be identical when more material is available.

Holothuria scabra, Jaeger.

Jaeger, 1833. De Holothuriis, p. 23.

There are four adult specimens, ranging in size from 170 × 90 mm. to 300 × 60 mm. All are of the usual finely speckled grey, and only one has large, dark blotches on the dorsal side. They were taken at Low Isles, and one is also labelled 1M1. I am also referring to this species two small, grey holothurians, only about 60 × 17 mm., whose calcareous deposits are in general like those of *scabra*. But a surprisingly large proportion of the buttons are asymmetrical and have 4–6 pairs of holes, while, as Théel says, in adults the buttons are mostly symmetrical, with three pairs of holes. Possibly in youth the character of the buttons is less fixed.

Stichopus chloronotus, Brandt.

Brandt, 1835, Rec. Actes Acad. Imp. Sci. St. Pétersb. p. 250. [Reprinted as Prodr. descr. Anim. p. 50.]

There are four specimens, ranging from 150 × 35 mm. to 240 × 45 mm. On two bright rust-brown specimens the dorsal and lateral papillae are very conspicuous. The other specimens (RP3) call for no comment.

Stichopus horrens, Selenka.

Selenka, 1867, Z. wiss. Zool. XVII, p. 316, pl. xviii, figs. 27–29.

There are five small adults (80–125 mm.), of which four were dredged at St. XIX, 10 fms., while one is labelled " South moat among dead branches of *Porites*." I am also referring to this species a little holothurian, about 10 mm. long by 6 mm. wide, translucent white, and with only 15 tentacles, but with calcareous particles which indicate it is a *Stichopus* and probably *horrens*. It is labelled " Gen. Survey, between Anchorage Reefs and Tripneustes Spit, 11.iv.29."

Stichopus variegatus, Semper.

Semper, 1868, Reisen im Archipel der Philippinen. I, Holothurien, p. 73, pl. xvi; pl. xxx, figs. 1, 6; pl. xxxv, fig. 1.

There are five specimens of this species, of which one very large one (300 × 100 mm.) is in poor condition, having been badly cut into. The smallest specimen measures 150 × 27 mm.

Actinopyga miliaris (Quoy and Gaimard).

Holothuria miliaris, Quoy and Gaimard, 1833, Voy. "Astrolabe," IV, p. 137.
Actinopyga miliaris, Bell, 1887, Sci. Trans. R. Dublin Soc. (2), III, p. 653, pl. xl, fig. 1.

This holothurian, commercially valuable as "black-fish," is represented in the present collection by two typical specimens, about 200 mm. long; one is from St. XVII, 19 fms. and the other is from St. XIX, 10 fms.

LIST OF STATIONS.

Particulars of reef-collecting stations are contained in "The Structure and Ecology of Low Isles and Other Reefs," by T. A. Stephenson, Anne Stephenson, G. Tandy and M. Spender, 'Great Barrier Reef Exped. 1928–1929, Sci. Reps.,' iii, 2, 112 pp., 27 pls., 1931. The dredging stations are as follows:

I. "Merinda." 24.xi.28. Linden Bank, 20 fathoms; coral bottom; dredge 30 minutes.

II, III. "Merinda." 24.xi.28. Linden Bank, 28 fathoms; shell and sand; dredge 10 minutes and 5 minutes.

IV. "Merinda" 24.xi.28. Linden Bank, 38 fathoms; mud; dredge 15 minutes.

V. "Merinda." 24.xi.28. Linden Bank, 37 fathoms; mud; Agassiz 30 minutes.

VI. "Merinda." 24.xi.28. Off Linden Bank, 114 fathoms; mud; dredge 15 minutes.

VII. "Merinda." 24.xi.28. Off Linden Bank, 114 fathoms; mud; Agassiz 15 minutes.

VIII. "Magneta." 21.ii.29. $1\frac{1}{2}$ miles N.W. Low Isle, 11 fathoms; mud; 2 dredges, 30 minutes and 15 minutes; 1 Agassiz 30 minutes; 1 grab.

IX. "Magneta." 22.ii.29. Penguin Channel, 12–14 fathoms; in clean pit and on mud at sides; 6 dredges about 20 minutes each.

X. "Magneta." 22.ii.29. Across Satellite Reef, working on sides to S.W. and N.E., 14–17 fathoms; coral, shell, gravel and mud; 2 dredges, 20 minutes each.

XI. "Magneta." 23.ii.29. Inside Wentworth Reef, 7 fathoms; mud and rock; 5 dredges, about 15 minutes each.

XII. "Magneta." 24.ii.29. Penguin Channel, 10–$15\frac{1}{2}$ fathoms; rock and shell gravel, mud on edges of pit; 5 dredges, about 30 minutes each.

XIII. "Magneta." 7.iii.29. $\frac{1}{2}$ mile W. of Two Isles, $16\frac{1}{4}$ fathoms; hard; 2 dredges, 20 minutes each.

XIV. "Magneta." 7.iii.29. $\frac{1}{2}$ mile S.E. Lizard Island, 19 fathoms; shell gravel; 3 dredges, 20–30 minutes each. Rich Halimeda.

XV. "Magneta." 8.iii.29. $\frac{1}{2}$ mile outside Cook's Passage, drifting N., 210 fathoms; clean sand and coral *débris*; 2 dredges, 30 and 45 minutes; 1 Agassiz, 30 minutes.

XVI. "Magneta." 9.iii.29. About $\frac{1}{2}$ mile W. of N. Direction Island, 20 fathoms; stony; 6 dredges, 20–30 minutes each.

XVII. "Magneta." 9.iii.29. About $\frac{1}{4}$ mile N. of N. Direction Island, 19 fathoms; sand, thick Halimeda: 2 dredges, 40 minutes each.

XVIII. "Magneta." 9.iii.29. $\frac{1}{2}$ mile S.E. Lizard Island, 20 fathoms; shell gravel, rich Halimeda: 1 Agassiz, 35 minutes.

XIX. "Magneta." 10.iii.29. About $\frac{1}{2}$ mile N. of Eagle Island, 10 fathoms; shell gravel, rich Halimeda: 3 dredges, 20–30 minutes.

XX. "Magneta." 10.iii.29. About $\frac{1}{4}$ mile N. Eagle Island, 6 fathoms; coral; 3 short dredges, quickly caught in coral.

XXI. "Magneta." 11.iii.29. $\frac{1}{2}$ mile N.W. Howick Island, 10 fathoms; mud and shell, forams: 2 dredges, 30 and 40 minutes.

XXII. "Magneta." 11.iii.29. To East of Snake Reef, $13\frac{1}{2}$ fathoms; mud with forams. and shells: 2 dredges, $\frac{1}{2}$ hour each.

XXIII. "Magneta." 12.iii.29. In lee of Turtle Isles, 8 fathoms; mud and shell; 3 dredges, two 30 minutes, one 45 minutes.

XXIV. "Magneta." 13.iii.29. $\frac{3}{4}$ mile N.E. Pasco Reef, $16\frac{1}{2}$ fathoms; hard and shell bottom: 6 dredges, all poor, as twine broke every time owing to great movement of boat.

XXV. "Magneta." 17.iii.29. In Papuan Pass, 20–25 fathoms; forams. and coral fragments; series of dredgings, $2\frac{1}{4}$ hours in all.

XXVI. "Magneta." 18.iii.29. Papuan Pass, ? fathoms; dredge and 340 metre wire lost.

XXVII. "Magneta." 18.iii.29. Papuan Pass, 17 fathoms; coarse sand; series of dredgings, $1\frac{1}{2}$ hours in all.

INDEX

DESCRIPTION OF PLATE I.

Ophiocoma delicata.

Fig. 1.—Aboral surface, natural size.
Fig. 2.—Aboral surface of disk and proximal arm-joints, × 3.
Fig. 3.—Oral surface of same, × 3.

Pericosmus macronesius.

Fig. 4.—Aboral surface, natural size.

Laganum dyscritum.

Fig. 5.—Paratype, aboral surface, natural size.
Fig. 6.—Paratype, oral surface, natural size.
Fig. 7.—Paratype, side view, natural size.
Fig. 8.—Holotype, aboral surface, natural size.
Fig. 9.—Holotype, oral surface, natural size.

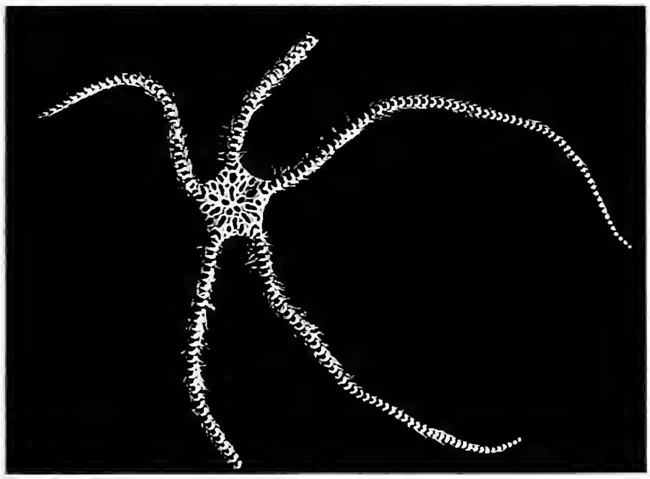


FIG. 1.

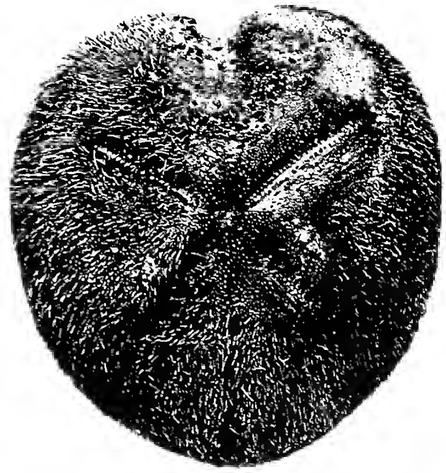


FIG. 4.

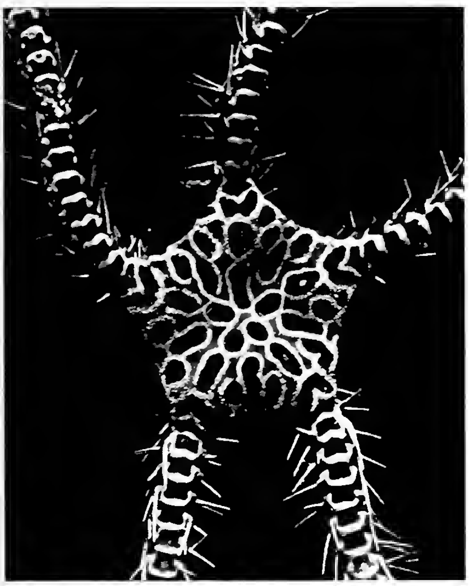


FIG. 2.

FIG. 5.

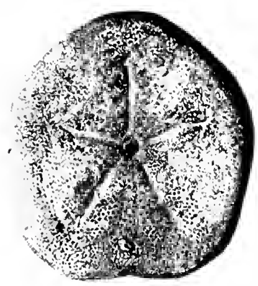


FIG. 6.

FIG. 7.

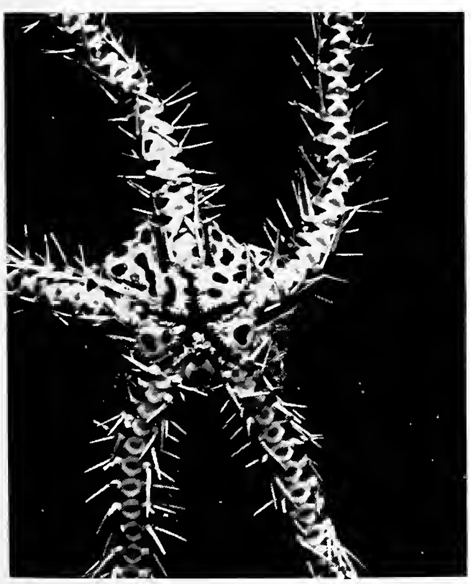


FIG. 3.

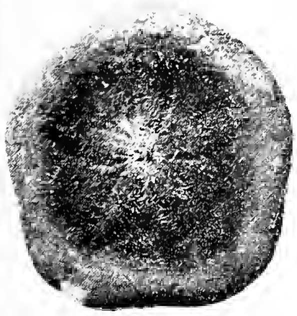


FIG. 8.

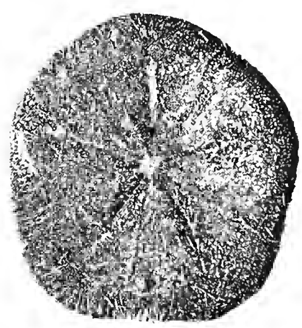


FIG. 9.

[*Adlard & Son, Ltd., Impr.*

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 8

ASTEROIDEA

BY

ARTHUR A. LIVINGSTONE.

The Australian Museum, Sydney.

(With the permission of the Trustees of the Australian Museum, Sydney

WITH TWO TEXT-FIGURES AND TWELVE PLATES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W. 1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W. 7
1932

Price Five Shillings

[*Issued 27th February, 1932*]

ADLARD & SON, LTD. 21, HART STREET, W.C.

Made and printed in Great Britain.

ASTEROIDEA

BY

ARTHUR A. LIVINGSTONE,

The Australian Museum, Sydney.

(With the permission of the Trustees of the Australian Museum, Sydney.)

WITH TWO TEXT-FIGURES AND TWELVE PLATES.

INTRODUCTION.

MANY of the specimens were secured on reefs of dead and living coral which encircle Low Isles, and, as was to be expected, *Linckia laevigata* was by far the most abundant species during the period of my visit. The discovery of *Nardoa pauciforis* living in association with *Nardoa novaecaledoniae* was fortunate, as it confirms past records of their occurrence together and the fact that their coloration in life is practically identical.

The finding of *Culcita novaeguineae* considerably extends the known range of the genus.

By far the most interesting material was that obtained by dredging. These specimens add much to our knowledge of the Australian asteroid fauna.

A representative set of specimens will be deposited in the British Museum (Nat. Hist.); the remainder, including types, will be placed in the collection of the Australian Museum, Sydney.

I wish to thank Dr. C. M. Yonge, Leader of the Expedition, for the opportunity of studying this collection, and Mr. G. C. Clutton, of the Australian Museum, for the care and skill he has exercised in the preparation of most of the photographs here reproduced.

Through the kindness of Mr. C. C. A. Monro, of the British Museum, I have been able to examine and incorporate in this work photographs of type and other material in the British Museum. I wish to record my gratitude for his kind assistance.

Although this is essentially a report upon the Asteroidea collected by the expedition, it has been found necessary in some cases to refer to specimens in other collections, so as to understand fully the material before me.

The species referred to in the report are as follows. Those marked with an asterisk were not collected by the expedition :

Astropecten polyacanthus, M. and Tr.
Astropecten granulatus, M. and Tr.
Astropecten zebra, Sladen.
Luidia forficifera, Sladen.
Archaster typicus, M. and Tr.
Tosia queenslandensis, sp. nov.
Stellaster incei, Gray.
**Stellaster equestris*, Retzius.
**Stellaster princeps*, Sladen.
Anthenea tuberculosa, Gray.
Oreaster australis, Lütken.
Oreaster nodosus (Linnaeus).
**Oreaster alveolatus*, Perrier.
Culcita novaeguineae, M. and Tr.
Asterope carinifera (Lamarck).
Fromia milleporella (Lamarck).
Nardoa pauciforis (v. Martens).
Nardoa novaecaledoniae (Perrier).
Nardoa rosea, H. L. Clark.
Linckia guildingii, Gray.
Linckia laevigata (Linnaeus).
Ophidiaster propinquus, sp. nov.
Tamaria fusca, Gray.
Tamaria megaloplax (Bell).
**Tamaria hirsuta* (Koehler).
**Tamaria ornata* (Koehler).
**Tamaria* sp.
Nepanthia (? *brevis*) (Perrier).
Patiriella exigua (Lamarck).
Echinaster luzonicus (Gray).
Metrodira subulata, Gray.
Acanthaster planci (Linnaeus).
Retaster insignis, Sladen.

SYSTEMATIC ACCOUNT.

Astropecten polyacanthus, Müller and Troschel.

Astropecten polyacanthus, Müller and Troschel, Syst. der Asteriden, 1842, p. 69, pl. v, fig. 3; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 63; H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 184.

LOCALITIES.—Dredged N.E. Low Isles, 8 fathoms, mud and stones, September, 1928 (1). Station XXIV. 13.iii.1929. Three-quarters of a mile N.E. Pasco Reef, 16½ fathoms, hard shell bottom (1).

DISTRIBUTION.—Red Sea to Zanzibar and Mozambique; Seychelles; Ceylon; Mergui; Andaman Islands; China; Japan; Philippines; Port Jackson, N.S.W.; Queensland; Admiralty Islands; Aru Islands; Fiji Islands; Hawaiian Islands.

Two specimens: R. = 72 mm., and 55 mm. The smaller specimen is badly distorted, and its R. measurement is only approximate.

Astropecten granulatus, Müller and Troschel.

(Plate VIII, figs. 2 and 3.)

Astropecten granulatus, Müller and Troschel, Syst. der Asteriden, 1842, p. 75; Döderlein, Denkschr. med.-naturw. Ges. Jena, VIII, 1896, p. 305, pl. xviii, figs. 30–30*a*; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 26.

LOCALITY.—Low Isles, off N. Anchorage, 9 fathoms, low tide, 17.x.1928 (Agassiz trawl) (1).

DISTRIBUTION.—Arafura Sea; Torres Strait; Queensland; Aru Islands; Philippines; Natal.

The single specimen has R. = 38 mm.

Astropecten zebra, Sladen.

Astropecten zebra, Sladen, J. Linn. Soc. Zool. XVII, 1883, p. 261; Sladen, "Challenger" Zool. XXX, 1889, p. 212, pl. xxxvi, figs. 3, 4; pl. xxxix, figs. 7–9; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 27 (and synonymy).

Locality.—Dredged quarter-mile S. of Cape Kimberley, 2.xii.1928, 4 fathoms, shell and gravel (2).

Distribution.—" The range of *zebra* appears to be from the Murray Islands westward through Torres Strait and northward to the Mergui Archipelago and the coast of Madras," H. L. Clark (*loc. cit.*). Queensland.

Two specimens : R. = 32 mm., 29 mm.

Luidia forficifera, Sladen.

Luidia forficifer, Sladen, " Challenger " Zool. XXX, 1889, p. 258, pl. xliv, figs. 5, 6 ; pl. xlv, figs. 5, 6 ; Döderlein, " Siboga " Exped., Mon. XLVI*b*, 1920, pp. 243, 278, figs. 28, 29 and fig. 3 in text (and synonymy) ; H. L. Clark, " The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 28.

Locality.—Station 12. 24.ii.1929. Penguin Channel, 10–15½ fathoms, rock and shell gravel, mud on edges of pit (2).

Distribution.—See Döderlein (*loc. cit.*, p. 243).

Two representatives of the genus *Luidia* (R. = 26 mm. and 21·5 mm.—both measurements from specimens in a slightly curled condition) are before me. After careful comparison with Sladen's description and figures they are considered referable to the above species.

Archaster typicus, Müller and Troschel.

Archaster typicus, Müller and Troschel, Mber. k. preuss. Akad. Wiss. 1840 p. 104 ; Müller and Troschel, Syst. der Asteriden. 1842, p. 65, pl. v, fig, 2, *a* and *b*; Sladen, "Challenger" Zool. XXX, 1889, p. 123; Fisher, Bull. U.S, Nat. Mus. 100, III, 1919, p. 180.

Localities.—Gen. Survey. The Sand Flat ; between Anchorage Reefs and Mangrove Park (4).

Distribution.—Widely distributed over Pacific and Indian regions.

Specimens of this species were commonly discovered on the sand flats at low tide, where they were partially buried.

Tosia queenslandensis, sp. nov.

(Plate V, figs. 1, 2, 7.)

Locality.—Pixie Reef, 6.vi.1929 (2). Paratype in the British Museum.

Distribution.—Great Barrier Reef, Queensland (Pixie Reef and Masthead Island, Capricorn Group).

Description.—Rays five. Two specimens examined : R. = 17 mm. ; r. = 10 mm. R. = 1·7 r. in larger specimen. Smaller specimen : R. = 13 mm. ; r. = 7 mm. ; R. = 1·8 r.

Rays well produced for a *Tosia*, tapering rapidly towards their extremities. Interbrachial arc comparatively deep and well rounded. Abactinal surface paved by a number of polygonal plates which are, for the most part, arranged in regular radiating series. Each plate is separated from its neighbour by a double row of large well-developed squarish

granules, which are plainly larger than those occurring on specimens of *Tosia australis* of the same size.

The abactinal plates are largest centrally, though plates in the distal portion of the median radial series may be larger than their immediate neighbours. This is particularly noticeable in the smaller specimen (R. = 13 mm.). The plates of the abactinal surface are mostly flat or very slightly depressed centrally, or ovate. The exceptions are the last three or four plates in the median radial series, which are conspicuously raised and dome-like—a condition particularly noticeable in the last plate of the series.

All plates of the abactinal surface, including the superomarginals, appear smooth at a casual glance, but minute inspection reveals them to be granular. The granules are not such as will rub off, but are scupltured on the plate, forming a definite and inseparable part of it. In other words the plates may be described as being pitted.

The superomarginal plates vary in number—either eight or nine being present. The inferomarginals number twelve. The superomarginals are not usually large, and are, with the exception of abnormal ones, of approximately uniform size. The inferomarginals are smaller than the superomarginals, particularly near the tips of the rays. Plates near the tips of the rays in both series of marginals are noticeably raised and swollen. A large terminal plate occurs, which is larger than any marginal, and possesses a small, though deep, pit on its tip.

The madreporite is larger than most plates of the abactinal surface. It is triangular with outwardly rounded or bulging sides, and separated from the abactinal plates bounding it by a single row of granules.

Inferomarginal and actinal plates much smoother than abactinals, yet showing faint traces of the type of granulation described above. The actinal plates are, on the whole, smaller than the abactinals. They are flat or slightly convex, and separated from one another by a double row of granules. The marginals are also separated by a double row of granules.

The adambulacral armature consists of a furrow series of two to three short, stout spines of equal length and size. At the back of each comb there are two or three granule-like spinelets. These latter merge into the general granulation.

Colour.—According to the label the colour in life is crimson.

Remarks.—This species is a member of the genus *Tosia*, as understood and restricted by Fisher (1919). Its nearest relative appears to be *Tosia australis*, Gray, but even to this species it is not nearly related. In the first place, *T. queenslandensis* is identifiable by the large and conspicuous terminal tubercle and the resulting marked derangement of the inferomarginal plates; by the deeply sinuated interbrachial arcs and the unusually heavy granulation separating the plates of both surfaces. In addition, the animal is much thicker and more stoutly constructed than any specimens of *T. australis* of the same size seen by me.

Besides the two specimens secured by the British Expedition, there is another in the Australian Museum from Masthead Island, Capricorn Group, Queensland, collected by W. Boardman and M. Ward in 1929. This specimen agrees in detail with the examples from the Barrier Reef.

T. queenslandensis seems to be a rare species, there being only three specimens known. Of the numerous collecting parties to the Great Barrier Reef none but the present expedition has met with it.

Stellaster incei. Gray.

(Plate I. figs. 3—6 ; Plate II. figs. 2—5.)

Stellaster incei, Gray, Proc. Zool. Soc. Lond. 1847, p. 76 ; Fisher, Bull U.S. Nat. Mus. 100, III, 1919, p. 326, pl. lxxix, figs. 1–3 ; pl. lxxx, fig. 1 (and synonymy) ; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29.

Locality.—Low Isles, about one mile north from the Northern Moat, 12 fathoms (1).

Distribution.—" East to the Mozambique coast (Simpson and Brown). India and Ceylon, Mergui Archipelago, Sumatra and Singapore, Philippines to Korea (? Sladen), south to New Guinea, Arafura Sea, Torres Strait, North, North-east and South Australia " (Fisher, 1919) : Queensland.

A specimen dredged in 12 fathoms off Low Isles is undoubtedly referable to this very variable species. It has been compared with material in the Australian Museum Collection identified by H. L. Clark, and found to agree in all the specific characters. R. = 82 mm. on the specimen before me, and on the abactinal surface 49 tubercles, and 11 scars of missing tubercles, are to be seen. Each furrow comb is made up of from six to seven (usually seven) very slender spines, which are webbed for a full three-quarters of their length. The webbed section is conspicuously corrugated owing to the presence of the spines. The subambulacral spines are flat and rounded at their free extremity. They occur usually in pairs, one spine being a little longer than its fellow. Rarely three spines are found together, and then the median spine is slightly larger than its fellows, which are more or less equal in size. Usually a small tubercle occurs on the outside of each spine, near the base, and just above the place of articulation. The large pincer-shaped pedicellariae, referred to by Fisher, agree with his account.

In a specimen from 25 miles S.E. of Double Island Point, Queensland, 35 fathoms, identified by H. L. Clark as *Stellaster incei*, the subambulacral spines are equal in number to those of the specimen before me, but very unequal in size. The spines of the furrow comb are webbed for less than half their length, and the abactinal tubercles are very few. Pedicellariae occur as described by Fisher.

In a specimen of *Stellaster incei* from Western Australia, which is in the Australian Museum collection, the characters are similar in most respects to those of the present examples, but there is a difference in the relative lengths of the spines of the furrow comb. The central pair are long and equal in length. The next adjoining pair are closely adpressed to the central pair, and are substantially shorter. The next two, which are on the outside, are only half as long as the central pair. A seventh spine sometimes occurs in the comb, and is usually stumpy and barely discernible. The spines of the comb are inconspicuously webbed for only a short distance.

Fisher's remark (*loc. cit.*, p. 328) that the " relationship between *incei* and *equestris* is by no means clear," has led me to examine a specimen of *equestris* in the Australian Museum from Nagasaki, Japan, 57 fathoms, collected by the " Vega " expedition in 1879, and identified presumably by Prof. T. Odhner, of Stockholm, from whom the specimen was received. In this specimen R. = 58 mm., and, after comparing it with a specimen of *S. incei* (R. = 59 mm.) from Albany Passage, North Queensland, 9–12 fathoms, collected by M. Ward, I prepared the following table with a view to providing a satisfactory means of discriminating the two species.

Stellaster incei.	*Stellaster equestris.*
(Specimen from Albany Passage, North Queensland, 9–12 fathoms. R. = 59 mm.	(Specimen from Nagasaki, Japan, 57 fathoms. R. = 58 mm.).
(1) Abactinal surface fairly rugged, uneven when dry, and studded with tubercles.	(1) Abactinal surface comparatively smooth, when dry, and devoid of tubercles.
(2) Superomarginal plates conspicuously tumid and well defined.	(2) Superomarginal plates only very slightly tumid and not well defined.
(3) Superomarginal plates in interbrachial arc comparatively narrow—2·75 mm. wide across middle.	(3) Superomarginal plates in interbrachial arc comparatively wide—3·75 mm. across middle.
(4) Inferomarginal plates narrow in interbrachial arc—3 mm. wide across middle.	(4) Inferomarginal plates in interbrachial arc comparatively wide—4 mm. wide across middle.
(5) Superomarginal and inferomarginal plates low. Measurement from top of superomarginal plate to bottom of inferomarginal plate in middle of interbrachial arc, 5 mm.	(5) Superomarginal and inferomarginal plates high. Measurement from top of superomarginal plate to bottom of inferomarginal plate in middle of interbrachial arc, 8 mm.
(6) General granulation comparatively coarse.	(6) General granulation fine.
(7) Rays noticeably narrow at base.	(7) Rays wide at base.
(8) Only adambulacral pedicellariae occur (at this age).	(8) Ventrolateral as well as adambulacral pedicellariae present.
(9) Subambulacral spines 2–4 (usually 3) in number, and unequal in size.	(9) Subambulacral spines single and of considerable size.

In the preceding table it will be noticed that use has been made of the width of the marginal plates, a character also used by Fisher (*loc. cit.*, pp. 327 and 328) in separating *incei* from *equestris*, but that author was unable to state at the time whether this character was constant in *equestris*. Little reliance is usually placed on granulation as a distinguishing character, and with only a single specimen of *equestris* before me, I can form no conclusion regarding its value as a specific differential. I have here simply recorded my observations on the available material.

Stellaster princeps, Sladen.

(Plate I, figs. 1 and 2; Plate II, fig. 1.)

Stellaster princeps, Sladen, " Challenger " Zool. XXX, 1889, p. 323, pl. lviii, figs. 1, 2; H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29.

Locality.—Western Australia (Australian Museum).

Distribution.—Known only from Western Australia and Booby Island, Torres Strait.

Representatives of this species were not obtained with the present collection, and the specimen before me, which is from Western Australia, is mentioned here only because of its importance. According to Clark (*loc. cit.*) the species is known only from the " Challenger " specimens from Booby Island, Torres Strait, and no further record can be found.

The specimen before me, which is undoubtedly *S. princeps*, has five rays: R. = 128 mm.; r. = 45 mm.

The abactinal surface agrees exactly with Sladen's description. Seven longitudinal series of plates occur at the base of the ray, and either three or four midway along that

structure. Conical and sharply pointed tubercles occur on the plates in the positions described, and the almost bare median radial series forms a very striking character.

The number of superomarginal plates (22) is exactly the same as that recorded by Sladen, and they are in complete accord with that author's description.

The spines on the inferomarginal plates evidently vary considerably in number, though in character and arrangement they are constant. Sladen gives three as the usual number of spines to each series, but the following observations on the present specimen show that the number varies.

The inferomarginals at the extreme tip of the ray are destitute of spines. Usually three, sometimes four, spines occur arranged in a lateral position, and in an oblique series on inferomarginal plates near the tip of the ray down to the interbrachial arc. In the interbrachial arc an oblique series of four or five may occur, and sometimes alongside these on the same plate a second series of two may be present, thus making a total of six or seven spines to one inferomarginal plate. The upper or outermost spine is always the longest and broadest; the longest spine measured on the present example is 7 mm.

The adambulacral plates and their armature, together with the two-valved pincer-shaped pedicellariae described as occurring in the immediate vicinity, are exactly as set down by Sladen. Likewise the actinal inter-radial areas and the position of the two-lipped valvate pedicellariae are in complete accord with his description.

Anthenea tuberculosa, Gray.

(Plate V, figs. 4—6.)

Anthenea tuberculosa, Gray, Proc. Zool. Soc. Lond. 1847, p. 77; H. L. Clark, "The Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 29, pl. vi, fig. 1 (and synonymy); H. L. Clark, Rec. Aust. Mus. III, 4, 1928, p. 385.

Localities.—Station XII. 24.ii.1919. Penguin Channel, 10 to 15½ fathoms, rock and shell gravel, mud on edges of pit (1). Station XIV. 7.iii.1929. Half mile S.E. Lizard Island, 19 fathoms, shell gravel, 3 dredges of 20 to 30 minutes each, rich Halimeda (1). Station XXII. 11.iii.1929. To E. of Snake Reef, 13½ fathoms, mud with forams and shells (1).

Distribution.—North Australia round to North Queensland.

Three juvenile specimens in the collection (R. = 22·5 mm., 16 mm., 12·5 mm.) agree so well with Sladen's* figures that I have no doubt as to their identity. Although Sladen was not sure of the identity of his "Challenger" material, Clark (*loc. cit.*) states that in his opinion Sladen was right in naming his specimens *tuberculosa*, Gray.

Oreaster australis, Lütken.

(Plate VI, figs. 1—6; Plate VII, figs. 1—4; Plate VIII, figs. 5—6; Plate X, figs. 1—4.)

Oreaster australis, Lütken, Vidensk. Medd. naturh. Foren. Kjöb. 1871, pp. 253, 263.
Pentaceros australis, Koehler, Echinod. Indian Mus. pt. vi, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 93, pl. x, fig. 2; pl. xiii, fig. 1.
Oreaster australis, H. L. Clark, Biol. Res. F. I. S. "Endeavour," IV, 1916, p. 49.
Oreaster hedemanni, Koehler (*loc. cit.*), p. 96, pl. x, fig. 6; pl. xi, fig. 7.

* Sladen, "Challenger" Zool. XXX, 1889, p. 340, pl. lvi, figs. 5–8.

LOCALITY.—Station XIX. 10.iii.1929. About half mile N. of Eagle Island, 10 fathoms, shell gravel, rich Halimeda (6).

A series of twelve specimens collected by the expedition from deep water are referable to this species. In determining the specimens, I have had the use of material collected by the "Endeavour," and named *O. australis* by H. L. Clark.

Earlier authors apparently did not have sufficient material at their disposal to describe the various growth stages of the species, and without this guidance the task of determining the growth stages and individual variation of the present series would have been doubly difficult. A critical study of the present series has led me to the belief that they all belong to the single species *australis* despite obvious differences, all of which I believe to be due to growth or individual variation. On this assumption, I am able to clear up important points concerning two other species of the genus, *gracilis* and *hedemanni*, as well as to attempt to establish more firmly *O. australis*.

I am of the opinion that *O. gracilis* is a distinct species and not merely a form of *O. australis*, as Clark (*loc. cit.*) thought it might be. As regards *hedemanni*, the juvenile specimens in the present series show it clearly to be a synonym of *australis*. Koehler (*loc. cit.*), who examined Lütken's type-specimen of *hedemanni*, gives a full description and excellent figures, and mentions that Lütken himself considered his specimen immature.

Koehler's description and figures fit the small and immature specimens of *O. australis* before me so well that there is no doubt in my mind as to the identity of *hedemanni*.

The following table (p. 249) is an attempt to set out briefly the differences due to growth and variation, together with the points of resemblance found in the members of the present series of *O. australis*. The specimens have been sorted into three sections, each representing a definite growth stage. Six are undoubtedly juveniles, five are young adults, and one is considered an old adult.

Only the specimens collected by the British expedition are dealt with in the following table, as they in themselves form a definite series.

The table will show how unreliable are the tubercles, and to a certain degree the spines of the adambulacral armature, as an aid to determining species even when specimens of approximately the same size are compared. Bell (1884) has made an attempt to define specific limits, but his work does not go far enough. Furthermore, he relies to a considerable extent upon the tubercles to distinguish between species; for example, *O. alveolatus* is said to be identifiable by the constant possession of inferomarginal tubercles (spines). This character, and indeed others relating to size, arrangement, and occurrence of tubercles, are perfectly worthless in my opinion for species such as *O. australis* and *O. alveolatus*. The six adult specimens in the present collection could easily, on such grounds, be split into three seemingly distinct species; but seeing that they all came from the same haul and possess characters in common, apart from the tubercles, such a procedure would, in the light of our knowledge of the Oreasters, be perfectly ridiculous.

Unfortunately, a paper by Döderlein (Zool. Jahrb. Syst., Jena, XL, pp. 409–440, 1916) upon the genus *Oreaster* is not available to me; but it seems perfectly clear that when more material is at hand for study purposes there will be far fewer valid species in the genus and much less difficulty in determining them.

It is quite possible, and even probable, that some authors may consider the specimens in the series before me as referable to *O. alveolatus*. This has not been overlooked, and in

	Juvenile specimens	Young adults.	Old adults.
Rays	(*a*) (Largest specimen) R. = 33·5 mm., r. = 13·5 mm., br. (between 2nd and 3rd superomarginal) 11 mm. R. = 2·4 r. and 3 br. (*b*) (Smallest specimen) R. = 20 mm., r. = 7·5 mm., br. (between 2nd and 3rd superomarginal)=6 mm. R.=2·6 r. and 3·3 br. (*a–b*) Ray tapering gradually.	(*a*) (Largest specimen) R. = 91 mm., r. = 36 mm., br. (between 2nd and 3rd superomarginal) 29 mm. R. = 2·5 r. and 3 br. (*b*) (Smallest specimen) R. = 78 mm., r. = 33 mm., br. (between 2nd and 3rd superomarginal) 31 mm. R. = 2·3 r. and 2·5 br. (*a–b*) Rays tapering gradually.	(*a*) (The only specimen) R. = 111 mm., r. = 42 mm., br.) between 2nd and 3rd superomarginal) 39 mm. R. = 2·6 r. and 2·8 br. (*a*) Rays stout and stumpy.
Disc	(*a*) Normally elevated, not conspicuous. (*b*) Slightly elevated.	(*a*) Evenly swollen and elevated. (*b*) Swollen and elevated, mostly centrally.	(*a*) Evenly swollen and well elevated; thick and massive.
Reticulate pattern (on abactinal surface)	(*a*) Becoming discernible. (*b*) Absent.	(*a*) Present, but showing signs of fading, particularly on rays towards extremities. (*b*) Well developed and uniformly distributed.	(*a*) Present on disc; ill defined.
Papular pores and areas (abactinal surface)	(*a*) Pores 1–9 in number; traces of irregularity in distribution. (*b*) Pores single or paired; arranged regularly.	(*a*) Pores numerous; areas merging into one another on rays. (*b*) Pores numerous; areas bounded by lines forming reticulate pattern.	(*a*) Pores numerous; areas forming continuous bands on rays and sometimes bounded by the lines of reticulate pattern on disc.
Tubercles:			
1. Pentagon formed by primary radials	(*a*) Well developed, conical and sharply pointed. (*b*) Prominent, sharply pointed and conical	(*a*) Large and well developed, conical, though inclined to be bluntly pointed. (*b*) Large, well developed and conical.	(*a*) Large and heavily developed, stumpy and roundly pointed—not strictly conical.
2. Granulation of tubercles	(*a*) Evenly clothed except for tip, which is smooth and nipple-like. (*b*) Ditto.	(*a*) Evenly clothed except for tip, which is smooth and nipple-like. (*b*) Ditto.	(*a*) Evenly clothed, except for tip, which is a bare rounded extremity, or represented by a series of large smooth granules.
3. Tubercles on median radials	(*a*) Present on about half the plates. (*b*) Only of isolated occurrence.	(*a*) Present on nearly every plate of series. (*b*) Present on most plates of series.	(*a*) Present on nearly every plate of series.
4. Tubercles on other plates of abactinal surface	(*a*) Occur fairly numerously as enlarged granules. (*b*) Occur sparingly as large granules.	(*a*) Fairly prominent and well developed, arranged in two or three rows and placed at angles of reticulate pattern. (*b*) Ill-developed (this character varies in young adults of approximately the same size); arranged in two or three rows and placed at angles of reticulate pattern.	(*a*) Prominent; inclined to be roundly pointed and stubby; in two or three rows, placed at angles of reticulate pattern.
5. Tubercles on superomarginals	(*a*) Fairly prominent, largest on plates in interbrachial arcs and near extremities of rays. (*b*) Present, though small, largest on plates near extremities of rays.	(*a*) Fairly well developed, though mostly confined to plates in interbrachial arcs and near tips of rays. (*b*) Wanting (young adults between sizes *a* and *b* are all provided with fairly well-developed tubercles.)	(*a*) Wanting.
6. Tubercles on inferomarginals	(*a*) Comparatively well developed, especially near tips of rays. (*b*) Present only on plates near tips of rays. Here they are very prominent and comparatively large for the specimen.	(*a*) Occur sparingly on plates in interbrachial arcs and near tips of rays. (*b*) Conspicuous, confined mostly to plates in interbrachial arcs.	(*a*) Wanting.
Number of superomarginals	(*a*) 15–16. (*b*) 12.	(*a*) 18. (*b*) 16–17.	(*a*) 19–12.
Number of inferomarginals	(*a*) 15–16. (*b*) 12.	(*a*) 19–20. (*b*) 18.	(*a*) 20.
Pedicellariae:			
1. Low bivalved slit-like	(*a*) Present both surfaces. (*b*) ,, ,, ,,	(*a*) Present both surfaces; rare on abactinal surface; small. (*b*) Present both surfaces; very minute; rare on abactinal surface.	(*a*) Present both surfaces; comparatively conspicuous.
2. Upright forceps pedicel	(*a*) Present both surfaces; rare on abactinal surface; confined mostly to ambulacral furrow actinally. (*b*) Absent (so far as can be made out).	(*a*) Present both surfaces; confined to ambulacral furrow actinally. (*b*) Ditto.	(*a*) Present both surfaces; fairly numerous abactinally and confined to ambulacral furrow actinally.
Adambulacral armature (furrow spines)	(*a*) 6–8. (*b*) 6–7.	(*a*) 8–10. (*b*) 8–10.	(*a*) Usually 8. The series is entirely hidden by the subambulacral spines.
Subambulacral spines	(*a*) 1–3. (*b*) 1–3.	(*a*) 2–3. (*b*) 2–3.	(*a*) 2–3.

order to ascertain the differences between that species and *O. australis,* I have used specimens named by H. L. Clark as *O. australis,* Koehler's description and figures of *O. australis,* and three specimens from New Caledonia attributed mainly on the ground of the locality to *O. alveolatus* which are in the collections of the Australian Museum (see figure of one; R. = 90 mm.) I can find no tangible differences to separate any of them. This would point to the conclusion that *O. alveolatus* is a synonym of *O. australis*—a conclusion which, in my opinion, the study of further material will substantiate. Scarcely any of the descriptions and figures of *O. alveolatus* wholly agree with one another. Even the specimens before me from New Caledonia cannot be said to agree very well with any existing records.

In order to make perfectly clear the character of the specimens upon which the preceding table and notes are based, as many as reasonably possible have been figured.

Oreaster nodosus (Linnaeus).

Asterias nodosa, Linnaeus, Syst. Nat., ed. X, 1758, p. 661.
Oreaster nodosus, Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 346, pl. cii, fig. 2 (and synonymy).

Locality.—Gen. Survey; 23.4.1929, Western Moat (1).

Distribution.—Region of Indian Ocean, East India Islands (north to Luzon), thence to New Caledonia and N.E. Australia in the Pacific.

Only a single specimen of this species was collected by the expedition. Specimens in the Australian Museum collection show the species to be fairly common in and around Port Denison, Queensland, where it lives between tide-marks during the winter season; it retires in the summer months to deeper water to avoid the severe seas of the monsoonal weather.

The colour is extremely variable, according to the careful colour notes taken by E. H. Rainford, of Bowen, Queensland, who states that the predominating colours are crimson and white.

The specimen from Low Isles before me is a juvenile measuring R. 39 mm.

Culcita novaeguineae, Müller and Troschel.

(Plate III, figs. 2 and 4; Plate IV, figs. 3 and 4.)

Culcita novaeguineae, Müller and Troschel, Syst. der Asteriden, 1842, p. 38; Goto, J. Coll. Sci. Tokyo, XXIX, Art. 1, 1914, p. 519, pl. xvii, figs. 252–262; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 32, pl. v, fig. 1.

Localities.—Low Isles, Gen. Survey, mud flat (adults). (Juvenile specimens were collected under stones in vicinity of Western Moat and Southern Moat, Rampart Y, 6.iv.1929 (7).)

Distribution.—Torres Strait and Queensland Coast; from Mozambique to Society Islands, and northward to the Andaman Islands, and to Kagoshima, Japan.

With the exception of the well-known *L. laevigata,* this species was as common as any other asteroid at Low Isles. Clark* records this species from "The Great Barrier Reef, Queensland," being unable to give a precise locality. He states that "if the locality were in the vicinity whence most of the present collection came" (between 17° and 19° S. lat.) "it would be a notable extension to the range of the genus." The present record,

* H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 185.

then, establishes the fact that the species occurs in the immediate vicinity of the area mentioned by Clark.

The youngest examples were found sheltered in reefs of dead and living coral, while the older ones were usually discovered on the open flat at low tide in about one to three feet of water. The two youngest specimens of the series of six before me bear a striking resemblance to those figured by Koehler,* and the remaining four agree with the key given by Goto (*loc. cit.*).

In the more mature specimens of the present series both the poriferous and net-like non-poriferous areas bear spiniform tubercles, which are noticeably bigger on the last-mentioned area. In the largest specimen, which is about half grown, some of the spiniform tubercles on the poriferous areas are as big as those on the non-poriferous areas, but as this character is not seen on younger examples it is obvious that it is due to age. The marginal zone is destitute of papulae—a feature most plainly visible on the largest specimen before me.

On the largest specimen five conspicuous humps of irregular shape occur in a more or less regular situation in the centre of the abactinal surface. Each is situated above and midway between the upturned extremities of the ambulacral furrows. The tops of the humps are seen to be constituted by extremely well-developed and thickened non-poriferous areas, and the humps themselves are produced by the sinking of the weaker surrounding non-poriferous areas during the process of drying and contracting. Younger examples show a thickened series of non-poriferous areas extending from near the margin midway between the rays up to the centre of the abactinal surface, but apparently these are not sufficiently developed to cause humps when dry and contracted.

In the youngest example the actinal plates are conspicuous. Each is clothed in granules, but those in the centre of each plate are much larger and coarser than their surrounding fellows. The large granules number from three to twelve. The whole series of specimens shows that, as the adult condition approaches, the well-defined areas of granules on the actinal surface become more indistinct, and in the largest example the grouping of the granules in the centre of each plate is almost indiscernible. Age does not seem to affect the number of inner adambulacral spines, which vary from five to six in each group, both in the smallest and largest example.

Of the varieties of the species, the present specimens seem to be nearest to var. *acutispinosa*, on account of the continuous poriferous areas, especially near the margins, but the abactinal surface cannot be said to be covered by the numerous coarse spines described as occurring on that variety.

Asterope carinifera (Lamarck).

Asterias carinifera, Lamarck, Anim. s. Vert. II, 1816, p. 556.
Asterope carinifera, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 33, pl. v, fig. 2.

Localities.—Gen. Survey; Low Isles, Western, Southern and Middle Moats (2).

Distribution.—Indo-Pacific. "It ranges from Mozambique, Zanzibar, and the Red Sea on the west, to the Hawaiian and Society Islands on the east, and from Queensland and New Caledonia on the south to Okinawa, Riu-kiu Islands on the north. It is

* Koehler, Echinod. Indian Mus. pt. vi, Asteroidea 2 (Shallow Water Asteroidea), 1910, pl. ix, figs. 4, 5.

also reported from the Galapagos Islands, Panama, and La Paz, Lower California, but these records are all old and need verification " (H. L. Clark, 1921).

The specimens collected or seen on the reefs of sand and coral were all of a very dark chocolate hue. As stated by Clark (*loc cit.*), some difficulty was experienced in seeing them, as their colour rendered them inconspicuous.

Fromia milleporella (Lamarck).

Asterias milleporella, Lamarck, Anim. s. Vert. II, 1816, p. 564.
Fromia milleporella, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 40.

Locality.—Low Isles (1).

Distribution.—" Red Sea, Mauritius, Madagascar, Ceylon to Samoa and Fiji Islands, *via* the Moluccas and Southern Philippines; New Caledonia; also Riu-kiu Islands, Japan " (Fisher, 1919). Mer, Torres Strait (H. L. Clark, 1921) and Low Isles, Queensland.

Prior to 1926, this species was not known from the mainland coast of Australia. Clark,* in that year, recorded six specimens from Coates Reef, Outer Great Barrier Reef, between 17° and 19° S. lat. The present record extends the range some little distance northward from that locality.

Only a single specimen exists in the present collection, and it was found among dead and living coral between tide-marks. The specimen was apparently mutilated at an early age, as two of the five arms are extremely short. R. = 3·4 r. and 3·1 br. Only one madreporite is present, but, after comparing the specimen with Queensland examples in the Australian Museum identified by H. L. Clark, I have no doubt as to its identity.

Nardoa pauciforis (von Martens).

(Plate III, fig. 3; Plate IV, fig. 6.)

Linckia pauciforis, von Martens, Arch. Naturgesch. XXXII, pt. 1, 1866, p. 69.
Nardoa pauciforis, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 51 (and synonymy).

Localities.—Gen. Survey, Low Isles; found exposed on reefs of dead and living coral between tide-mark (2). Batt Reef, off Port Douglas, N. Queensland; in same habitat as above (3).

Distribution.—Flores, Philippines, Amboina, Queensland, Erub and Mer, Torres Strait.

The discovery of this species at Low Isles and Batt Reef is not remarkable, as it has already been collected at Green Island, near Cairns, and at localities in Torres Strait (*fide* Clark, *loc. cit.*). The present record merely links up these areas.

The species was noticeably common both at Low Isles and Batt Reef, and is, as noted by Clark, extremely sluggish, the individuals observed making no attempt to hide for protection or to avoid the hot sunshine. Of the five selected specimens before me the one with R. = 95 mm. is the largest. The papulae in each area vary considerably in number, and the comparative smallness of the abactinal plates is noticeable. In the

* H. L. Clark, Rec. Aust. Mus. XV, 1926, p. 185.

largest example the number of abactinal plates across the base of the ray between the two superomarginal series comes within the limit (12–13) set by Clark. In some cases, however, the number increases to fourteen. while in the smallest example (R. = 74 mm.) only eleven are to be counted.

The colour in life of the species agrees well with Clark's description.

Nardoa novaecaledoniae (Perrier).

(Plate IV. fig. 1 : Plate V. fig. 3.)

Scytaster novaecaledoniae, Perrier, Archiv Zool. Exp. Gén. IV, 1875, p. 426.
Nardoa novaecaledoniae, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 52 (and synonymy).

LOCALITY.—Low Isles ; found exposed on reef of dead and living coral between tide-marks (1) ; Yonge Reef, Inner Moat, 6th June, 1929 (1).

DISTRIBUTION.—Mer, Torres Strait, Queensland, New Caledonia, Philippines, Andaman Islands, Maldives (? Minikoi and New Ireland). Ceylon. Moluccas.

A single four-rayed specimen of this species was handed to me, by a member of the collecting party, as an abnormal *N. pauciforis*. By the colour and shape of the specimen one could easily mistake it for its commoner ally. and the confusion was not noticed by any of us until after a later and more careful examination had been made. The likeness in colour of the two species has been already recorded by Clark (*loc. cit.*), who examined specimens from Green Island, near Cairns, and Mer, Torres Strait, where both species were found to occur together. R. = 81·5 mm. in the present example. The abactinal plates are not crowded on the disc or on the basal end of the rays, and in both of these areas the plates range from 2 to 4 mm. in diameter. Running from about the middle of the ray towards the distal or free extremity, the abactinal plates are seen to become more crowded, with the result that, at, and near the extreme tip, they are very numerous, small, and densely packed together. The abactinal plates on the extremities of the rays are, like those on the disc and basal ends of the rays, provided with conspicuous central granules.

Nardoa rosea, H. L. Clark.

(Plate VIII, fig. 7.)

Nardoa rosea, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 53, pl. x, fig. 1 ; pl. xxix, figs. 1, 2.

LOCALITY.—Station XX. 10.iii.1929. About ¼ mile N. of Eagle Island, 6 fathoms, coral (1).

DISTRIBUTION.—Known only from Australian waters. Murray Islands, Torres Strait ; Eagle Island, Queensland ; Heron Island, Capricorn Group, Queensland.

This sea-star is not common, as past and present records show. Further, I have never seen it alive on any part of the Great Barrier Reef that I have visited.

The single specimen collected by the expedition has its rays very much distorted but the R. is calculated to be about 72 mm. It agrees perfectly with the original description and shows no variation.

That adult specimens do not vary is confirmed by another specimen in the Australian Museum from Heron Island, Capricorn Group, Queensland. This specimen is also responsible for the extension of the known range of the species to a considerable distance south of Low Isles.

Linckia guildingii, Gray.

Linckia guildingii, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 285 ; H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 67.

Locality.—Yonge Reef, Outer Barrier, Inner Moat, 5.vi.1929 (1).

Distribution.—Almost circum-tropical. See Clark (*loc. cit.*) for complete range.

With characteristic clarity Clark has provided a means by which this species can be readily recognized. The single specimen before me is labelled the " Brown Linckia," together with the information that " it was nearly this colour " (dull grey-brown as described by Clark for dry specimens) " when alive—no blue." This, with other characters of a structural nature, leaves no doubt as to the identity of this specimen.

Although large (R. = 125 mm.) the specimen is by no means of a record size, for Clark refers to a specimen from Bermuda with R. = 215 mm.

Although only one specimen of the species was secured, T. A. Stephenson, a member of the expedition, informs me (*in litt.*) that the species was " very common on Yonge and Ribbon Reefs."

Linckia laevigata (Linnaeus).

(Plate III, fig. 1 ; Plate IV, figs. 2 and 5.)

Asterias laevigata, Linnaeus, Syst. Nat., ed. x, 1758, p. 662.
Linckia laevigata, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 64, pl. ix, figs. 1, 2 ; pl. xxvi, fig. 1 (and synonymy).

Locality.—Low Isles ; exposed on reefs of dead and living coral between tide-marks, especially on Fungia and Madrepore Moats (4).

Distribution.—See H. L. Clark, 1921, p. 65, for detailed and complete information.

This handsome blue species was the commonest and most conspicuous sea-star both on Batt Reef and Low Isles, but examples from only the last-mentioned locality were collected. The largest of the four specimens collected has R. = 157 mm. and the smallest R. = 56·5 mm. It is noticeable that the two smallest examples, although showing little difference in ray measurement, exhibit a comparatively marked difference in the breadth of these structures. The individual mentioned above with R. = 56·5 mm. has br. = 13 mm., while the second smallest has R. = 63·5 mm. and br. = 10 mm. Although the difference in breadth is only 3 mm. it is considerable, if we take into account the almost equal length of the rays. When the two specimens are compared, the rays of the smaller specimen could be properly described as stumpy and fairly thick, while those of its slightly larger fellow should be called slender.

Clark (*loc. cit.*) showed that this type of variation is not unknown in the species, but, in his view, it occurred only when the specimens were from different localities. The present record demonstrates that such variation can take place in specimens from the same locality.

Ophidiaster propinquus, sp. nov.*

(Plate XII. figs. 5, 11, 16, 18.)

LOCALITY.—Ribbon Reef, 4.vi.1929 ; seaward sloping zone (1).

DESCRIPTION.—R. = 26·5 mm. ; r. = 5·5 mm. ; br. (at base of ray) = 5 mm. R. = 4·8 r. and 5·03 br. Disc distinct, though not prominent. Rays slightly unequal in length, semicircular abactinally, and flat, or nearly so, actinally. The width of the rays changes little throughout their entire length, the slight taper becoming noticeable only upon close examination. The plates of the abactinal surface are arranged in more or less regular order, especially near and at the margins, where a shallow though well-marked furrow separates them longitudinally. Mid-dorsally, however, the various series of plates become slightly disarranged and tend to intermingle with one another.

The marginal plates of both series are well marked, much more so than those near the top of the abactinal surface. The granulation of the abactinal surface is even. Only the plates of the marginal series bear larger granules centrally.

The papular areas are not clearly defined, nor arranged with any regularity except near the marginals. The number of papulae to an area varies from 1–7. The papulae are scarce on the abactinal surface of the disc, where they usually occur singly or in pairs. The areas are not, on the whole, deeply sunken.

The terminal plate is slightly over 1 mm. across. It is bare, and in one case sparsely pitted. The madreporite is smooth, well channelled, and measures 1 mm. in diameter.

The plates of the actinal surface are arranged in a very regular series. Three series of actinolateral plates occur. The actinal plates are much coarser in their granulation than the plates of the abactinal surface, and moreover, their central areas bear granules of comparatively large size.

The furrow spines are arranged two to a plate. They are of equal size and definitely club-shaped. Each pair of spines, not each individual spine, is separated from its adjoining fellow pair by small granules varying in number from one to three. Usually three granules occur. At the back of the furrow series, and separated from it and from one another by one or two rows of small granules, are two rows of blunt, stumpy, spine-like tubercles, two of which correspond to three furrow spines. The spine-like tubercles of the outer row, although smaller, correspond to those of the first or inner row. Outside the second series there occur occasionally further spine-like granules or tubercles, which, although merging in some cases into the spine-like tubercles of the second series, are usually separate, and not arranged in any continuous regular order.

No pedicellariae.

Colour.—Pale biscuit yellow with darker blotches abactinally (specimen dried after a short preservation in alcohol).

Affinities.—The closest known relative of this species appears to be *O. squameus* Fisher. *O. propinquus* has been compared with a specimen of *O. squameus* from Mer, Murray Islands, Torres Strait, kindly lent by H. L. Clark, together with Fisher's original description and figures. The characters found separating *O. propinquus* from *O. squameus* are as follows: Papular areas and pores not conspicuous. Plates not markedly convex. Granules not coarse; those covering abactinal plates never noticeably enlarged centrally.

* Specific name indicates the species' affinity with *O. squameus*, Fisher.

Granules occur between each *pair* of furrow spinelets, not between each spinelet. *Two* rows of granule-like tubercles outside furrow series. No granules with the appearance of scales.

Tamaria, Gray.

Tamaria, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 283.

This genus has, in recent years, been subjected to a comparatively brief overhaul, but lack of material, coupled with scanty and sometimes contradictory information, has seriously hampered workers in deciding on the validity of its various species. Even the genus cannot be said to be secure in its present status.

A study of material on loan from the Museum of Comparative Zoology, Cambridge, Mass., U.S.A., of material secured by the expedition, photographs of authentic material in the British Museum (Nat. Hist.) and specimens in the Australian Museum has led me to the following main conclusions:

That *T. fusca*, Gray, is not a very variable species, and that, in Australian waters at least, it is distinct and easily recognizable.

That the genus *Tamaria* is of doubtful validity.

That many specimens associated with *T. fusca* by earlier authors belong to distinct species.

That Bell's records of species are unreliable owing to his errors in identification.

That Sladen's *tuberifer* should be relegated to the synonymy of Bell's *megaloplax* on the ground of priority.

That distinct species occur in the same zone.

That the species of the Queensland coast are distinct from those at present known to occur in western and north-western waters of the Continent.

In brief, I believe the status of the various species mentioned to be as follows:

(a) *Tamaria fusca*, Gray. Valid.

(b) *Tamaria fusca* (Fisher's 1919 specimens). From available information they are identical with Gray's specimen.

(c) *Tamaria fusca* (Perrier's record). Valid. (Gray's specimen used.)

(d) *Tamaria fusca* (Studer's "Gazelle" specimens labelled *O. fuscus* and mentioned by Clark, 1921) referable to *T. hirsuta*, Koch.

(e) *Tamaria* sp. Bell's Zanzibar material. Most certainly not *Tamaria fusca*, Gray.

(f) *Tamaria fusca* (Clark's 1921 Holothuria Bank specimens). Not *T. fusca*, Gray, but the two species described by Koehler—*ornata* and *hirsuta*.

(g) *Tamaria lithosora*, H. L. Clark. Valid ?

(h) *Tamaria megaloplax*, Bell (Bell's specimens from Holothuria Bank). See Clark's reference to these specimens under (f).

(i) *Tamaria megaloplax*, Bell. Valid. ("Alert" specimen from Albany Island.)

(j) *Tamaria ornata*, Koehler. Valid.

(k) *Tamaria hirsuta*, Koehler. Valid.

(l) *Tamaria tuberifera*, Sladen ("Challenger" and subsequent material), in the synonymy of *T. megaloplax* Bell (Albany Island specimen).

Tamaria fusca, Gray.

(Plate IX. figs. 4—7: Plate XI. figs. 1, 2. 3, 4, 7, 8: Plate XII. figs. 1, 4, 6, 7, 10, 15, 17, 19.)

Tamaria fusca, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 283.
Ophidiaster fuscus, Perrier, Arch. Zool. exp. gén. 1875, p. 396; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 388, pl. xcv, figs. 5, 5*a–c*; pl. ciii, fig. 4: pl. civ, fig. 1; pl. cxi, figs. 5, 6.
Tamaria fusca, Livingstone, Rec. Aust. Mus. XVIII. No. 1, 1930, p. 22, pl. viii, figs. 2–5.

LOCALITIES.—Station XVI, 9.iii.1929: about ½ mile W. of N. Direction Island, 20 fathoms. stony. five juveniles: Station XIV, 7.iii.1929: ½ mile S.E. Lizard Island, 19 fathoms, shell gravel, rich Halimeda, one juvenile; off Lindeman Island, Whitsunday Passage, Queensland, 9 fathoms, 1929, 1 specimen possibly adult, Austr. Mus. (this specimen was recorded and figured by me in a previous paper); Port Denison. Queensland, one seemingly half-grown example, Austr. Mus.

DISTRIBUTION.—Philippine Islands, Celebes and coast of North Queensland (other records exist, but I believe the specimens were incorrectly identified).

Photographs of Gray's type of *fusca* kindly supplied by the authorities of the British Museum (Nat. Hist.) have enabled me to establish definitely the status and characters of the species. In the past errors have been made in identification owing to the lack of definite information and other causes. In order to avoid or reduce further complications the photographs before me have been reproduced in this work.

The species has the reputation of being one of the most variable in the family. This is, I think, not wholly warranted, as all the specimens available to me, which collectively form a good series illustrating growth stages, point to an opposite conclusion. Fisher (1919) and Clark (1921) have, in my opinion, relegated too much to the synonymy of *fusca* and assumed too much variation.

Six juveniles before me are undoubtedly referable to *fusca*, and none of them is similar to specimens previously regarded as young or immature examples of *fusca*. Further, the young of *fusca* are easily recognized and associated with the adult.

Fisher's (1919) specimens from the Philippines and Celebes are referable to *fusca*, and the information concerning them was used in determining a specimen from Whitsunday Passage, Queensland, dealt with in an earlier paper (*loc. cit.*, 1930). I see no reason to question that determination after examining photographs of Gray's type. A study of this specimen together with a smaller one in the collections of the Australian Museum and of the juveniles collected by the expedition has caused me to review and alter the synonymy submitted tentatively by H. L. Clark. *Linckia megaloplax*, Bell (Albany Island specimens and Holothuria Bank specimens) should have no place in the synonymy of *fusca*. *O. ornatus* and *O. hirsutus* of Koehler are apparently distinct species. The specimens available to me suggest that Koehler was justified in separating the two forms from one another and from *T. fusca*.

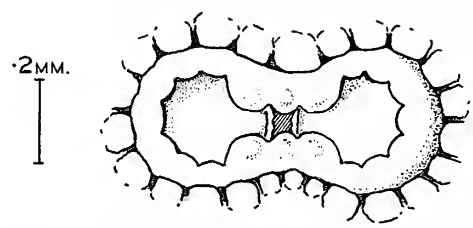
A "Gazelle" specimen, the property of the Museum of Comparative Zoology, Cambridge, Mass., U.S.A., named *Ophidiaster fuscus* by Studer and referred to by Clark (1921) under the heading of *Tamaria fusca*, is before me. I am convinced it does not belong to Gray's species, but is referable to *T. hirsuta*, Koehler. Further mention of it is made under that heading.

After examining photographs of specimens of Bell's supposed *O. fuscus* from Zanzibar I find that they do not represent examples of *fusca* of Gray, and am at a loss to place them.

They may be related to specimens identified and listed by Simpson and Rudmose-Brown (1910) as *Linckia marmorata.* The photographs have been reproduced for the benefit of future workers wishing to investigate the question of the African examples, as well as to support my opinion as to the status of Bell's material.

DESCRIPTION.—Rays five (measurements given under the heading of material examined). Disc noticeably elevated. The rays taper evenly and rapidly from base to a comparatively sharp point. In a large specimen (R. = 50 mm.) the papular areas are, as usual, arranged in six regular rows. They are small and deeply sunken between the prominent rows of abactinal plates. The papular pores number from 1–9. The areas containing the greatest number of pores are situated near the base of the ray and on the disc. Smaller specimens possess from 1–4 and 1–6 pores to an area. The papular areas situated on either side of the median series of plates do not reach the tip of the ray, and therefore only four series of areas can be counted in that region. This character can also be observed in juvenile examples. It was also described by Clark (1921) for *T. lithosora.*

The abactinal plates are noticeably elevated, even in young examples. The plates on the disc are the largest to be found. All abactinal and superomarginal plates are clothed by densely packed granules, among which here and there occur larger and more



TEXT-FIG. 1.—*Tamaria fusca,* Gray. Pedicellaria drawn from Gray's type specimen.

conspicuous granules of a smooth and bald nature. These larger granules occur in the centre of the plate. They number from 2 to 15 to a plate, and are similar to those described by Clark as occurring in *T. lithosora.* The granules between the papular pores are very uneven in size.

The terminal plate is hemispherical and smooth.

The madreporite is elevated and prominent.

The pedicellariae are particularly prominent and plentiful in juvenile examples of the species.

The inferomarginal plates, although densely clothed in small granules, are destitute of the large and bald granules characteristic of the superomarginal and abactinal plates, and bear instead, in almost every case, a central blunt spine or tubercle.

Two series of actinolateral plates occur.

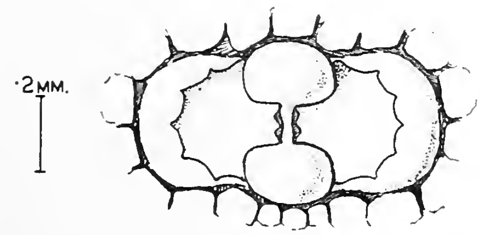
The furrow spines number two to a plate. No granules occur between these spines. Behind the furrow series is a single series of prominent ovoidal spine-like granules, which are spaced much closer together in the region of the mouth than anywhere else.

MATERIAL EXAMINED.—Eight specimens. Six juveniles with R. ranging from 7 mm. to 17 mm. (Brit. Exp. Coll.); one apparently half-grown specimen, R. = 30·5 mm., and one seemingly fully grown adult, R. = 50 mm. (Austr. Mus. Coll.); this latter specimen was figured by me in a previous paper (1930).

COLOUR.—Only the largest specimen shows the brown and " Bougainvillea " purple

markings. The other examples have been preserved in alcohol and have lost all their natural colours.

Affinities.—The only species to which *fusca* can now be regarded as closely related is *T. lithosora*, H. L. Clark. Judging from Clark's description and figures (1921), I was at first inclined to place *lithosora* into the synonymy of *fusca*, but before doing so more information was sought from Clark. Being unable to send me his type for examination Clark kindly supplied the following information (*in litt.*): "With regard to my species *lithosora*, I have just compared the type with Fisher's figures of *fusca* and the difference between them is very marked . . . in *lithosora* the tubercles are very rounded and smooth and not in the least like tubercles or small spinelets such as one sees in *fusca*. I might add that in *lithosora* on the oral surface there is a very complete series of subambulacral spines, which give the furrow a very different appearance from what I have seen either in specimens or figures of *fusca*." Clark admits, however, the possibility of his *lithosora* being only an extreme form of *fusca*, but until his specimen is examined more critically and compared with authentic material of *fusca*, one cannot arrive at a very definite and satisfactory conclusion.



Text-fig. 2.—*Tamaria megaloplax* (Bell). Pedicellaria drawn from Bell's specimen of *Linckia megaloplax* from Albany Island; Alert Expedition.

Tamaria megaloplax (Bell).

(Plate IX, figs. 1—3; Plate XII, figs. 8, 12, 14.)

Linckia megaloplax, Bell, Rep. Zool. Coll. "Alert," 1884, p. 126 (Albany Island specimen).
Ophidiaster tuberifer, Sladen, "Challenger" Zool. XXX, 1889, p. 404, pl. lxv, figs. 1–4; Döderlein (in Semon), Zool. Forschungsreisen in Aust. V, 1896, p. 317; Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea) 1910, p. 148; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 393.
Tamaria tuberifera, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 90, pl. viii, fig. 1; Livingstone, Rec. Aust. Mus. XVIII, No. 1, 1930, p. 22, pl. iv, fig. 3; pl. viii, figs. 1, 3, 4.

Locality.—Station XXII, 11.iii.1929. To East of Snake Reef, $13\frac{1}{2}$ fathoms, mud with forams and shells (1).

Distribution.—Coast of Queensland, Torres Strait, Andaman Islands and Philippines.

A set of photographs of Bell's original Albany Island specimen ("Alert" Coll.) of *Linckia megaloplax* is before me. There is no doubt that Sladen's *Ophidiaster tuberifer* is the same species. It is most unfortunate that such a well-known name as *tuberifer* should be sunk as a synonym in favour of Bell's hitherto somewhat uncertain name, but as Bell's species has priority, there is no alternative. Specimens from Fitzroy Island, Port Curtis and Port Denison, Queensland, were also included by Bell under his original description of *megaloplax*, but only the specimen from Albany Island can be regarded as authentic at present. These remaining specimens may or may not belong to one species—the uncertainty arising from the apparent laxity with which Bell appended names.

Bell's description certainly fits the photographs of the Albany Island specimen, and I see no reason for designating any other specimen from the mixed batch he had before him as the type of Bell's species. Other specimens erroneously named *megaloplax* by Bell (Holothuria Bank material referred to by Clark, 1921) do not belong here, and have been dealt with later under separate headings.

It is interesting to be able to confirm Clark's surmise (1921, p. 90) that *T. tuberifera,* Sladen, is really Bell's Albany Island *megaloplax.*

Only one specimen of the species is in the expedition's collection, R. = 31·5 mm.

Tamaria hirsuta (Koehler).

(Plate X, figs. 5—7 ; Plate XI, figs. 9 and 10 ; Plate XII, fig. 20.)

Ophidiaster hirsutus, Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 149, pl. xviii, figs. 5, 6 ; Fisher, Bull. U.S. Nat. Mus. 100, 1919, p. 388.

Tamaria fusca, H. L. Clark (*non* Gray), "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 89 (part), pl. xxviii, figs. 1, 2.

DISTRIBUTION.—Andaman Islands and Holothuria Bank off north-west Australia.

I have before me on loan one of the specimens from Holothuria Bank identified by Bell as his *megaloplax* and referred to by Clark (*loc. cit.*) as Koehler's *hirsutus*. In the first place I am reasonably confident that Bell's identification was incorrect, and that the Holothuria Bank specimens are not conspecific with Bell's *megaloplax* from Albany Island. Secondly, I venture to disagree with both Fisher and Clark as to the status of *hirsuta*. In differing from the more mature opinion of these authorities I submit that the photographs of *hirsuta* and *fusca* in this work are of specimens of distinct species.

T. hirsuta seems to be closer to *megaloplax* than to *fusca*, but here also there are differences, and I prefer to await more evidence before dropping the specific name, *hirsuta*. Lastly, greater reliance should be placed on Koehler's judgment, as he was doubtless aware of the existence of *fusca*, *tuberifera* and *megaloplax*, even though they were then only imperfectly known ; and he would presumably have taken them into consideration before establishing a new species for his specimen. In any case the specimens and photographs before me seem to justify Koehler's action. I include under these species Studer's "Gazelle" specimens, one of which was referred to by Clark (1921) as *T. fusca*. Clark's specimen is before me on loan, and I am confident it should not be attributed to *T. fusca*. One other specimen, in the collection of the Australian Museum, also belongs here. It has R. = 26 mm., and is accompanied by a label bearing the locality "Western Australia." It is identical with Studer's specimen before me. In conclusion it may be pointed out that the species of *Tamaria* from the north and north-west coasts of Australia have, so far as is known, no representatives on the Queensland coast, and conversely ; therefore no overlapping of species is believed to occur.

Tamaria ornata (Koehler).

(Plate XII, fig. 2.)

Ophidiaster ornatus, Koehler, Echinod. Ind. Mus. VI, Asteroidea, 2 (Shallow Water Asteroidea), 1910, p. 151, pl. xviii, figs. 3, 4.

Tamaria fusca, H. L. Clark (*non* Gray), "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 89 (part).

Distribution.—S. coast Ceylon and Holothuria Bank off north-west Australia.

I have before me a second specimen from Holothuria Bank (R. = 22 mm.) labelled by Bell as his *megaloplax* and considered by Clark closely to resemble the type of Koehler's *ornatus*. Clark, through whom the present specimen was secured on loan, considered it referable to *fusca*, and reduced *ornatus* to the synonymy of that species. The specimen, however, shows characters which serve instantly to separate it from *fusca*, and as it cannot be reasonably referred to any other species of the genus, one must regard it as representing a distinct species.

Tamaria sp.

(Plate XI, figs. 5, 6, 11, 12; Plate XII, figs. 3, 9, 13.)

Localities.—12 fathoms, Fitzroy Island, Queensland (smallest specimen); Port Curtis, Queensland, 12 fathoms (Austr. Mus. specimens).

In order to review all the material available to me, I have included under this heading three further specimens in the collections of the Australian Museum. The smallest specimen has R. = 29 mm., and is from 12 fathoms off Fitzroy Island, Queensland. This is one of Bell's localities for some of the examples of *megaloplax* gathered by the "Alert," but I have no reason to believe that the present specimen was secured by that expedition. A slightly larger specimen, R. = 34 mm., was collected recently in Port Curtis, Queensland, in a depth of 12 fathoms together with a further specimen, the largest of the three, with R. = 103·5 mm. Port Curtis is another of the localities of *megaloplax* given by Bell in his "Alert" report. All three specimens seem to be closely related and possibly referable to the one species. They are most certainly not referable to Bell's *megaloplax*, as they might be in view of the localities from which they came. Either of the two smallest specimens at first sight might be taken for the young of *megaloplax*, but comparison shows that *megaloplax*, even in the young stage, possesses definite roundly rectangular and large papular areas which are not deeply sunken, whereas the two small Tamarias under discussion have very small and sunken papular areas. The papular areas themselves furnish a very reliable means of distinguishing species of the genus.

The largest specimen is by far the most interesting, as it seems to alter one's views in regard to the status of the genus *Tamaria*. It has been compared with examples of *Hacelia helicosticha*, Sladen, to which it appears to be closely related.

The salient feature regarded as distinguishing *Tamaria* from *Ophidiaster* is the number of rows of papular areas, yet it is known that the former genus approaches the latter in the occasional presence of isolated papulae on the actinal surface immediately below the inferomarginals. Although these additional papulae have been considered by H. L. Clark to be unimportant as generic characters, their presence in greater numbers than ever known before raises the question of their differential value and of the limits of the two genera. The large specimen before me appears to possess characters intermediate between those of *Ophidiaster* and *Tamaria*. It cannot be referred to any of the known species of *Tamaria*, and, indeed, it is uncertain whether it belongs to the genus, although I have provisionally placed it there. On the other hand, if it were not for the unusually large number of papular pores below the inferomarginals the specimen could be regarded as agreeing in many respects with *T. scleroderma*. There are, however, important characters other than the papular areas which instantly separate the latter species from that represented by my specimen. The general form of the body and rays alone are sufficient.

The two smaller specimens possess only six series of papular areas. The larger of the two is the more likely to be the young of the largest specimen. The extra series of papular areas obviously becomes manifest with age. Pedicellariae occur on the three specimens, and resemble those found on *T. megaloplax.*

All three have been figured in detail in order to assist future workers on this difficult group.

Nepanthia (? *brevis*) (Perrier).

(Plate V, figs. 8 and 9.)

Asterina (*Nepanthia*) *brevis,* Perrier, Arch. Zool. Exp. Gén. V, 1876, p. 241.
Nepanthia brevis, Sladen, " Challenger " Zool. XXX, 1889, p. 387, pl. lxiii, figs. 3–5 ; H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 95, pl. vi, figs. 3, 4.

Locality.—Dredged 8 fathoms N.E. of Low Isles, mud and stones, September, 1928 (1).

Distribution.—Torres Strait and North-west Australia (Philippines and N. Queensland doubtful).

I refer with some hesitation this single specimen to the above species. Several species of the genus, including *brevis,* are ill defined, and their descriptions confusing. Fisher (1919) had difficulty in deciding whether one of his specimens belonged to *joubini,* Koehler, or whether it was a six-rayed example of *brevis.* The specimen before me resembles that of Fisher and I find a similar difficulty in its attribution.

The Australian Museum specimens of the genus are at present on loan to H. L. Clark, who intends to make a detailed study of them in conjunction with other material and to publish the results of his work. Without this material I am unable to make comparisons with the present specimen, but to avoid confusion as to its nature two illustrations of it are given.

The specimen possesses five madreporites. R. = 34 mm., r. = 10 mm., rays curled.

Patiriella exigua (Lamarck).

Asterias exigua, Lamarck, Anim. s. Vert. II, 1816, p. 554.
Patiriella exigua, Verrill, Amer. J. Sci. XXXV, 1913, p. 484.
Asterina exigua, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol Carn. Instn. X, 1921, p. 97, pl. vii, figs. 6, 7 (and synonymy).
Patiriella exigua, H. L. Clark, Rec. S. Aust. Mus. III, 1928, p. 392.

Locality.—Low Isles (10) (almost general in occurrence) ; Snapper Island, N. of Low Isles. Specimens were taken from under coral boulders and stones between tidemarks (10). Gen. Survey, Inner Ramparts, 20.iii.1929 ; Tripneustes Spit, 21.iii.1929 ; Asterina Spit, 20.iii.1929 ; Region F.9, 4.iv.1929 ; Three Isles, 5.v.1929.

Distribution.—Madagascar, Cape of Good Hope, Mauritius, Andaman and Nicobar Islands, Java, Moluccas, Philippines, South, East and North Australia.

Clark (*loc. cit.*) has recorded that this sea-star is abundant at Erub, and it is also common at the above localities.

The largest specimen has a diameter of 29 mm., but in the majority this measurement is between 18 and 25 mm. Ten specimens were collected in each of the localities given above, and all are five-rayed, except one which possesses six rays.

Echinaster luzonicus (Gray).

Othilia luzonica, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 282.
Echinaster luzonicus, H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 98, pl. x, figs. 2–4 (and synonymy).

LOCALITIES.—Gen. Survey. 24.iv.1929 (4). Upper platform of Luana Reef. Taken also by members of the Australian Museum Staff in the vicinity of the Western and Middle Moats. Station XVII, 9.iii.1929, about quarter-mile N. of North Direction Island, 19 fathoms, sand and thick Halimeda (1); Station XIX, 10.iii.1929 about half-mile N. of Eagle Island, 10 fathoms, shell gravel, rich Halimeda (2).

DISTRIBUTION.—New Ireland, Queensland, New Caledonia, Amboina, Admiralty Islands, Ceylon, Philippines, New Britain, Northwest Australia and Torres Strait.

Four specimens were collected from under dead coral boulders on the weedy sand flat at Low Isles and seven secured from deeper water. The diversity in the number of rays is clearly illustrated on the specimens before me; of the shore forms the largest has five rays, two have six, and one seven. All tolerably complete specimens have two madreporites each. In life, all were of a more or less dark or blackish hue, but when dried, after preservation in alcohol, the colour varied considerably, as is usual in the species. Two are of a rusty red hue, with darker irregular blotches, while another is an ashen colour with dark sepia patches. The fourth is dark greenish yellow on the abactinal surface, and noticeably paler on the actinal surface. The adambulacral plates bear a distinct subambulacral spinelet near the margin of the furrow.

Metrodira subulata, Gray.

(Plate VIII, figs. 1 and 4.)

Metrodira subulata, Gray, Ann. Mag. Nat. Hist. VI, 1840, p. 282; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 406 (and synonymy); H. L. Clark, "Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 100.

LOCALITIES.—Station XII, 24.ii.1929. Penguin Channel, 10–15½ fathoms, rock and shell gravel, mud on edges of pit (1). Station XXII, 11.iii.1929. To E. of Snake Reef, 13½ fathoms, mud, forams, shells (1).

DISTRIBUTION.—Macclesfield Bank; Philippine Islands, Torres Strait, Aru, Amboina, N.W. Australia; N.E. Australia; George Sound, New Zealand; Bay of Bengal; Ceylon (*fide* Fisher, *loc. cit.*). In regard to the New Zealand record of the species, on the authority of Sladen, followed by Fisher, Mortensen* states that it may be regarded as fairly certain that *M. subulata* does not occur in New Zealand waters, and that the record was evidently based upon "unreliable Museum labels."

Clark (*loc. cit.*) doubts the accuracy of Bell's "Alert" identification. The present record, however, proves that the species extends down the coast of Queensland *via* the Great Barrier Reef from Torres Strait.

SPECIMENS EXAMINED.—Two five-rayed examples, R. = 60 mm., r. = 7·5 mm.; R. = 35 mm., r. = 3·5 mm.

* Papers from "Dr. Mortensen's Pacific Expedition, 1914–16, XXIX, Ech. New Zeal. and the Auckland-Campbell Islands," Vidensk. Medd. naturh. Foren. Kjöb. Bd. LXXIX, 1925, p. 263.

Acanthaster planci (Linnaeus).

Asterias planci, Linnaeus, Syst. Nat. ed. X, 1758, p. 823.
Acanthaster planci, H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 101.

Locality.—Low Isles, reef, 20.vii.1929 (1).

Distribution.—Zanzibar, Arabian Gulf and Red Sea across to Society and Hawaiian Islands, including Philippines and Riu-kiu Islands, Moluccas, Fiji, Samoan Islands, Mauritius, Torres Strait and Queensland.

A single specimen, measuring 202 mm. across, is referable to this species.

Retaster insignis, Sladen.

Retaster insignis, Sladen, J. Linn. Soc. Zool. XVI, 1882, p. 200; Sladen, " Challenger " Zool. XXX, 1889, p. 482, pl. lxxvi, figs. 3, 4; pl. lxxvii, figs. 11, 12; Fisher, Bull. U.S. Nat. Mus. 100, III, 1919, p. 460; H. L. Clark, " Echinod. Fauna Torres Strait," Pap. Dept. Mar. Biol. Carn. Instn. X, 1921, p. 103.

Localities.—Station XVII, 9.iii.1929. About $\frac{1}{4}$ mile N. of North Direction Island, 19 fathoms, sand, thick Halimeda weed (2). Station XVI, 9.iii.1929. About $\frac{1}{2}$ mile W. of North Direction Island, 20 fathoms, stony (1).

Distribution.—Philippines; Amboina; Banda Sea; Arafura Sea; Torres Strait and Thursday Island; Samoa; Port Molle, Queensland and probably Port Jackson, New South Wales.

Three specimens: R. = 46 mm.; R. = 23·5 mm.; R. = 15·5 mm. According to the label the largest animal was in life dark red on a grey background.

INDEX

DESCRIPTION OF PLATE I.

Fig. 1.—*Stellaster princeps*, Sladen. Specimen from Western Australia (Austr. Mus Coll.) (R. = 128 mm.). Abactinal view. (Slightly under half nat. size.)

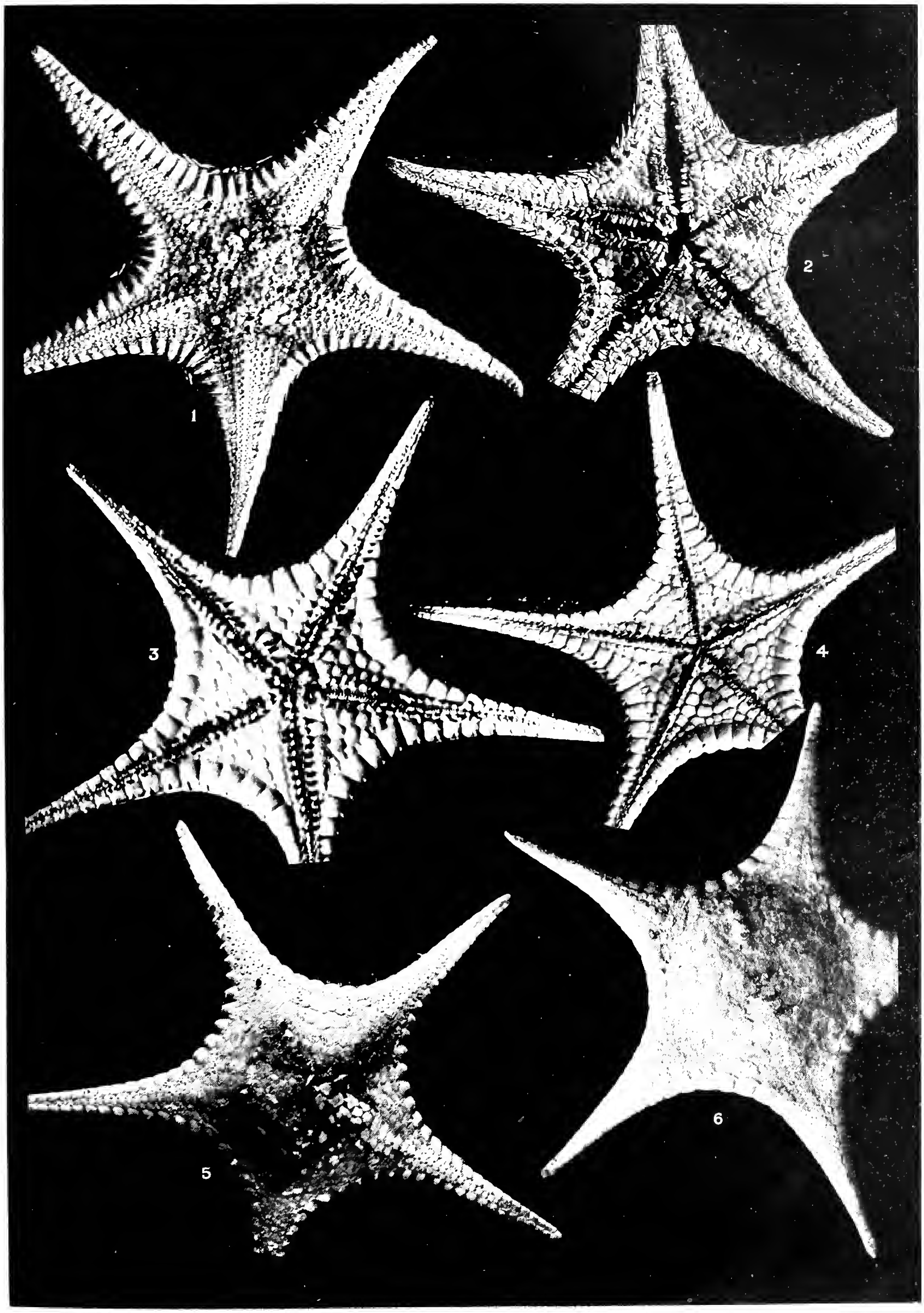
Fig. 2.—*Stellaster princeps*, Sladen. Actinal view of above specimen. (Slightly under half nat. size.)

Fig. 3.—*Stellaster equestris* (Retzius). Specimen from Nagasaki, Japan (Austr. Mus. Coll.) (R. = 58 mm.). Actinal view. (About nat. size.)

Fig. 4.—*Stellaster incei*, Gray. Specimen from Albany Passage, North Queensland (Austr. Mus. Coll.) (R. = 59 mm.). Actinal view. (Slightly under nat. size.)

Fig. 5.—*Stellaster incei*, Gray. Abactinal view of the above specimen (R. = 59 mm.). (Slightly under nat. size.)

Fig. 6.—*Stellaster equestris* (Retzius). Abactinal view of above specimen from Nagasaki, Japan (Austr. Mus. Coll.). (Slightly under nat. size.)



[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE II.

Fig. 1.—*Stellaster princeps*, Sladen. Specimen from Western Australia (R. = 128 mm.). Ambulacral furrow. (× 5.)

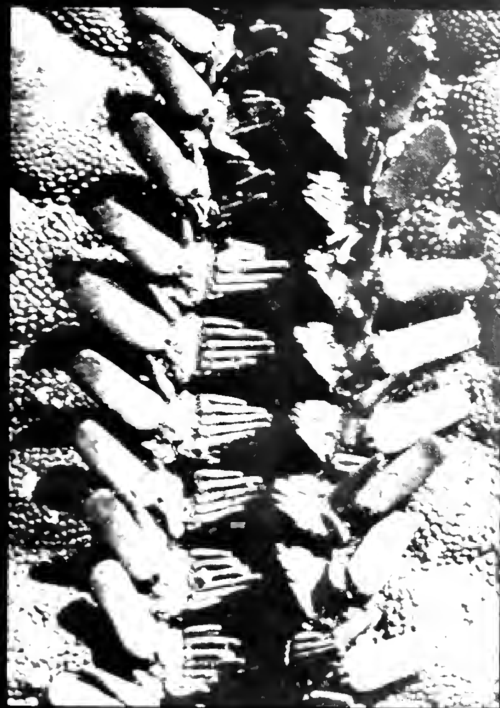
Fig. 2.—*Stellaster incei*, Gray. Specimen from Western Australia (R. = 69 mm.). Ambulacral furrow. (× 5.)

Fig. 3.—*Stellaster equestris* (Retzius). Specimen from Nagasaki, Japan (R. = 58 mm.). Ambulacral furrow. (× 5.)

Fig. 4.—*Stellaster incei*, Gray. Specimen from Albany Passage, North Queensland (R. = 59 mm.). Ambulacral furrow. (× 5.)

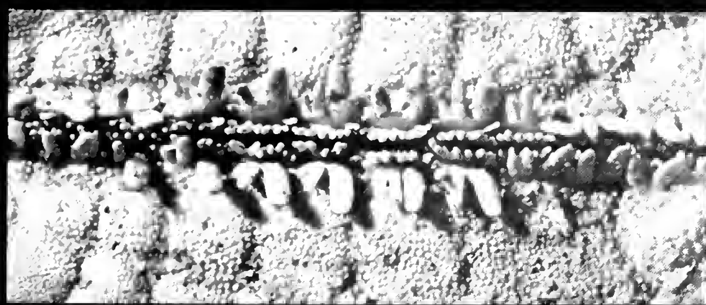
Fig. 5.—*Stellaster incei*, Gray. Specimen from Low Isles, North Queensland (R. = 82 mm.). Ambulacral furrow. (× 5.)

1

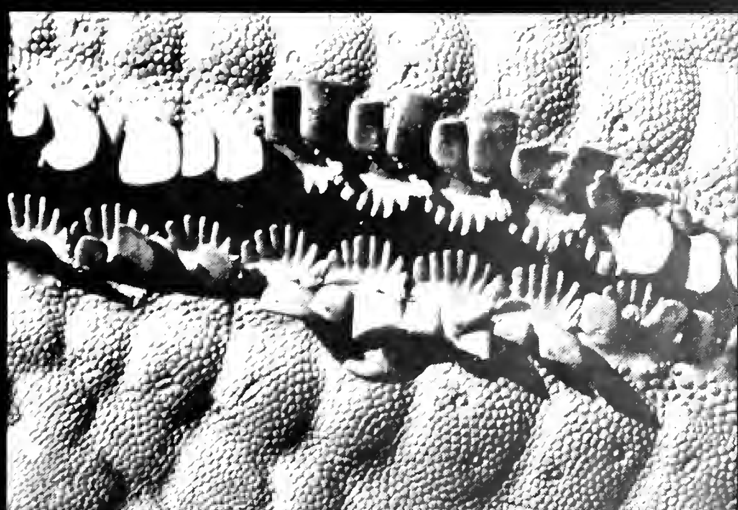


2

3



4



5

[*Adlard & Son, Ltd., Impr.*

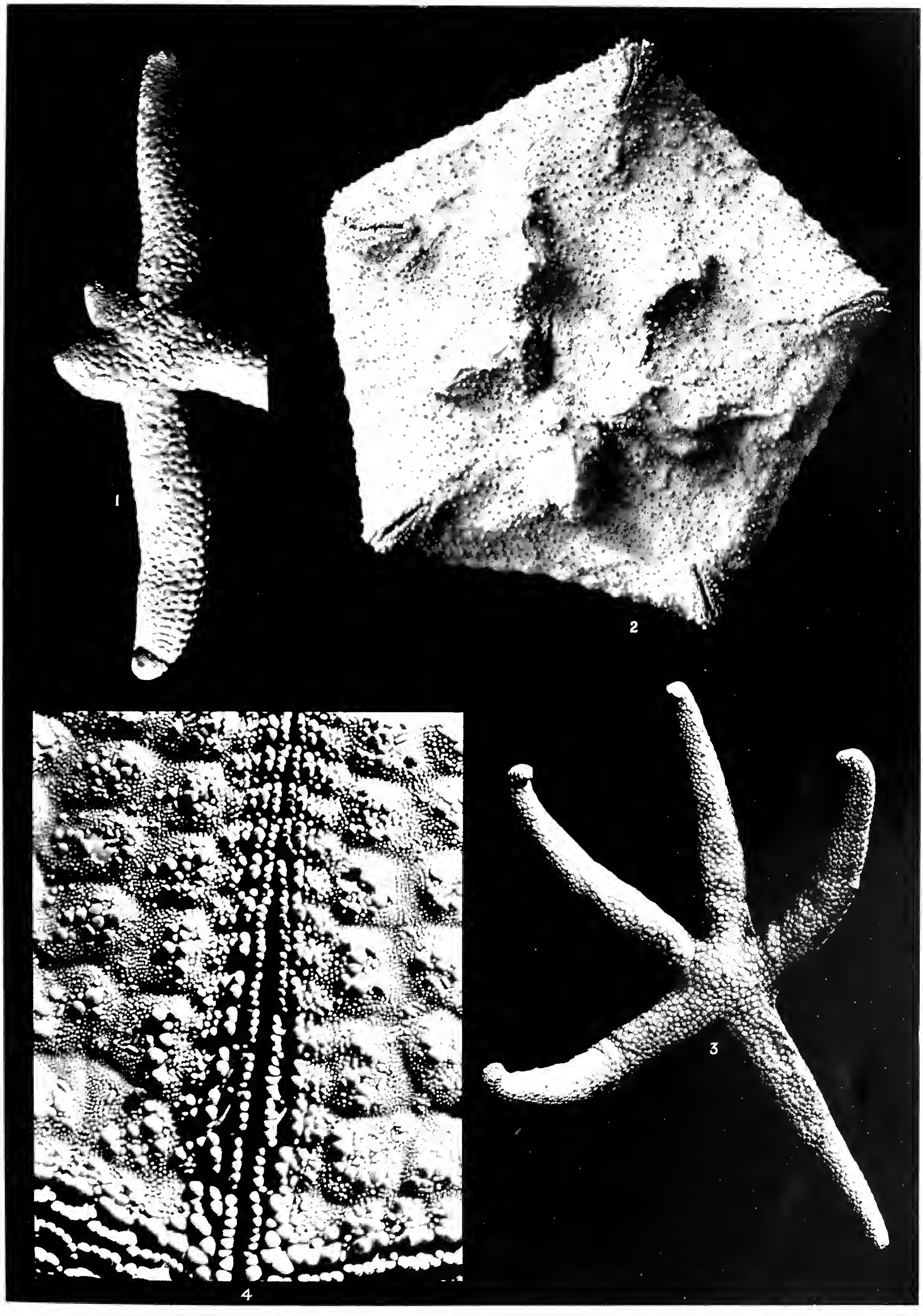
DESCRIPTION OF PLATE III.

Fig. 1.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles. Abactinal view. (Slightly over nat. size.)

Fig. 2.—*Culcita novaeguineae* (M. and Tr.). Half-grown specimen from Low Isles, showing the five "humps" described in text. The continuous poriferous areas are more conspicuous near the margins. (About two-thirds nat. size.)

Fig. 3.—*Nardoa pauciforis* (v. Mart.). Specimen from Low Isles. Abactinal view. (Slightly over half nat. size.)

Fig. 4.—*Culcita novaeguineae* (M. and Tr.). Ambulacral furrow of juvenile specimen from Low Isles. ($\times$ 5.)



Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE IV.

FIG. 1.—*Nardoa novaecaledoniae* (Perrier). Specimen from Low Isles. Ambulacral furrow. (× 5.)

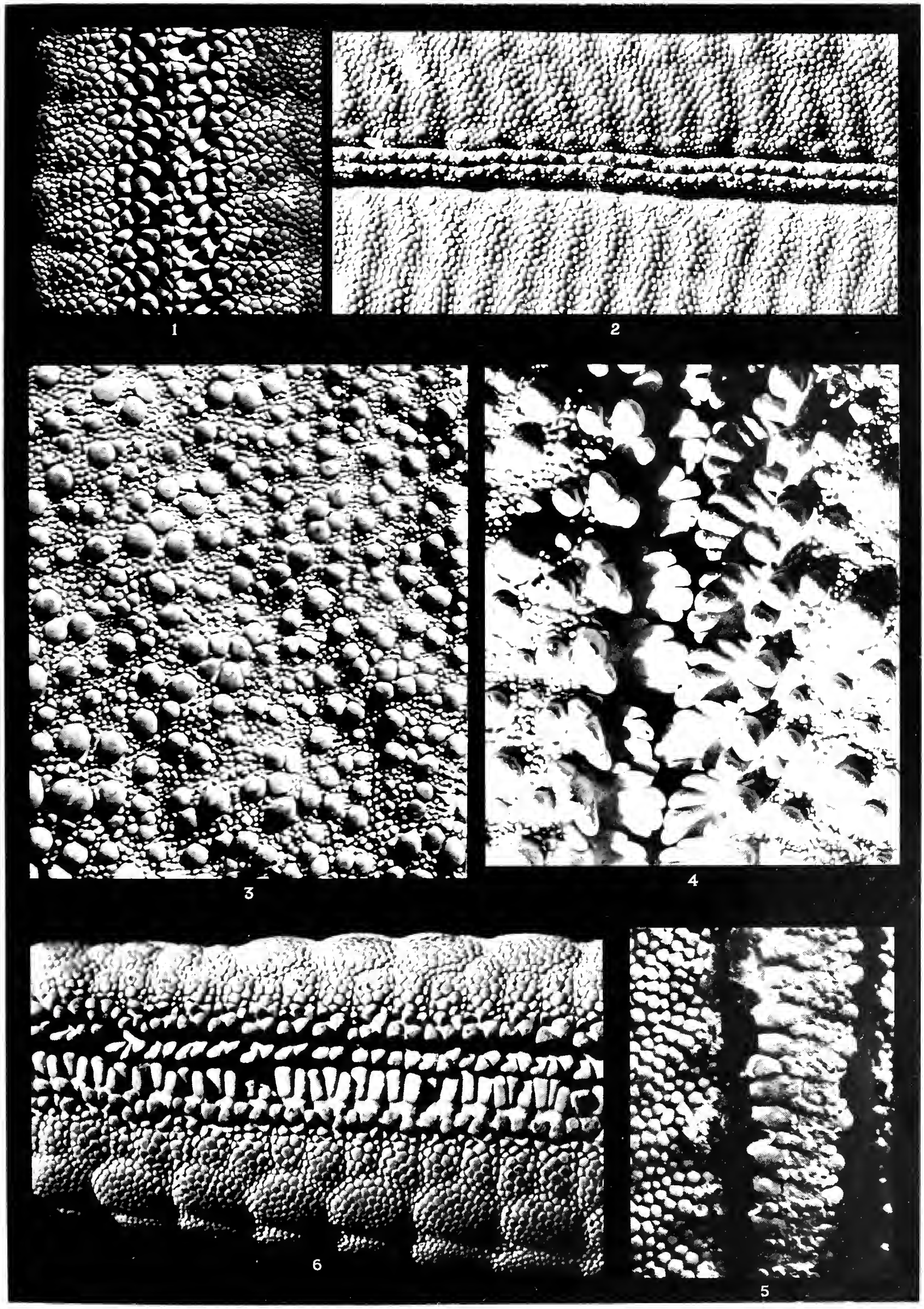
FIG. 2.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles (R. = 157 mm.). Showing granules between the furrow spinelets. (× 5.)

FIG. 3.—*Culcita novaeguineae* (M. and Tr.). Portion of actinal surface of half-grown specimen from Low Isles. (× 5.)

FIG. 4.—*Culcita novaeguineae* (M. and Tr.). Same specimen as above showing ambulacral furrow. (× 5.)

FIG. 5.—*Linckia laevigata* (Linnaeus). Specimen from Low Isles (R. = 157 mm.). Dissection showing furrow spinelets separated by granules. (× 8.)

FIG. 6.—*Nardoa pauciforis* (v. Mart.). Specimen from Low Isles. Ambulacral furrow. (× 5.)



J. Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE V.

FIG. 1.—*Tosia queenslandensis*, sp. nov. Holotype (R. = 17 mm.). Abactinal view. (Slightly under × 2.)

FIG. 2.—*Tosia queenslandensis*, sp. nov. Actinal view of holotype. (Slightly under × 2.)

FIG. 3.—*Nardoa novaecaledoniae* (Perrier). Four-rayed example from Low Isles. (Slightly over half nat. size.)

FIG. 4.—*Anthenea tuberculosa*, Gray. R. = 22 mm. Actinal view. (About $1\frac{1}{2}$ times nat. size.)

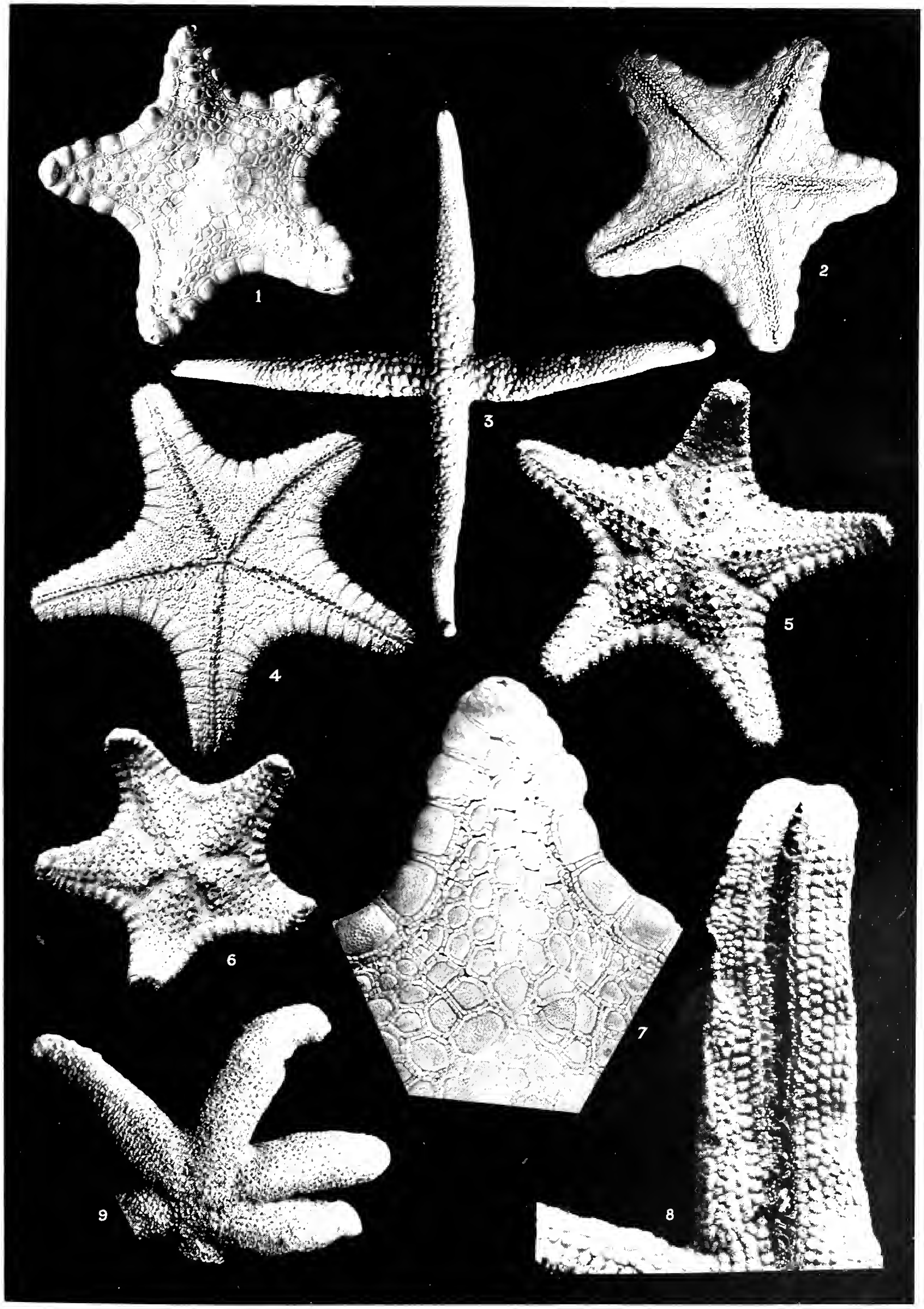
FIG. 5.—*Anthenea tuberculosa*, Gray. Abactinal view of same specimen. (About $1\frac{1}{2}$ times nat. size.)

FIG. 6.—*Anthenea tuberculosa*, Gray. R. = 16 mm. Abactinal view. (Slightly over $1\frac{1}{2}$ times nat. size.)

FIG. 7.—*Tosia queenslandensis*, sp. nov. Portion of abactinal surface of holotype. (Slightly over × 4.)

FIG. 8.—*Nepanthia* (? *brevis*, Perrier). R. = 34 mm. Ambulacral furrow. (Slightly over × 3.)

FIG. 9.—*Nepanthia* (? *brevis*, Perrier). Abactinal view of above specimen. (Slightly over nat. size.)



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE VI.

Fig. 1.—*Oreaster australis*, Lütken. Actinal view of smallest juvenile specimen (R. = 20 mm.). (Nearly × 2.)

Fig. 2.—*Oreaster australis*, Lütken. Actinal view of smallest adult specimen (R. = 78 mm.). (Slightly under nat. size.)

Fig. 3.—*Oreaster alveolatus* (Perrier). Abactinal view of one of three specimens in the collections of the Australian Museum from New Caledonia (R. = 90 mm.). (About two-thirds nat. size.)

Fig. 4.—*Oreaster australis*, Lütken. Abactinal view of largest young adult (R. = 91 mm.). (Slightly over two-thirds nat. size.)

Fig. 5.—*Oreaster alveolatus* (Perrier). Actinal view of above specimen (fig. 3) (R. = 90 mm.). (Slightly over two-thirds nat. size.)

Fig. 6.—*Oreaster australis*, Lütken. Abactinal view of smallest juvenile specimen. Same specimen as fig. 1. (Nearly twice nat. size.)

Adlard & Son, Ltd., Impr.

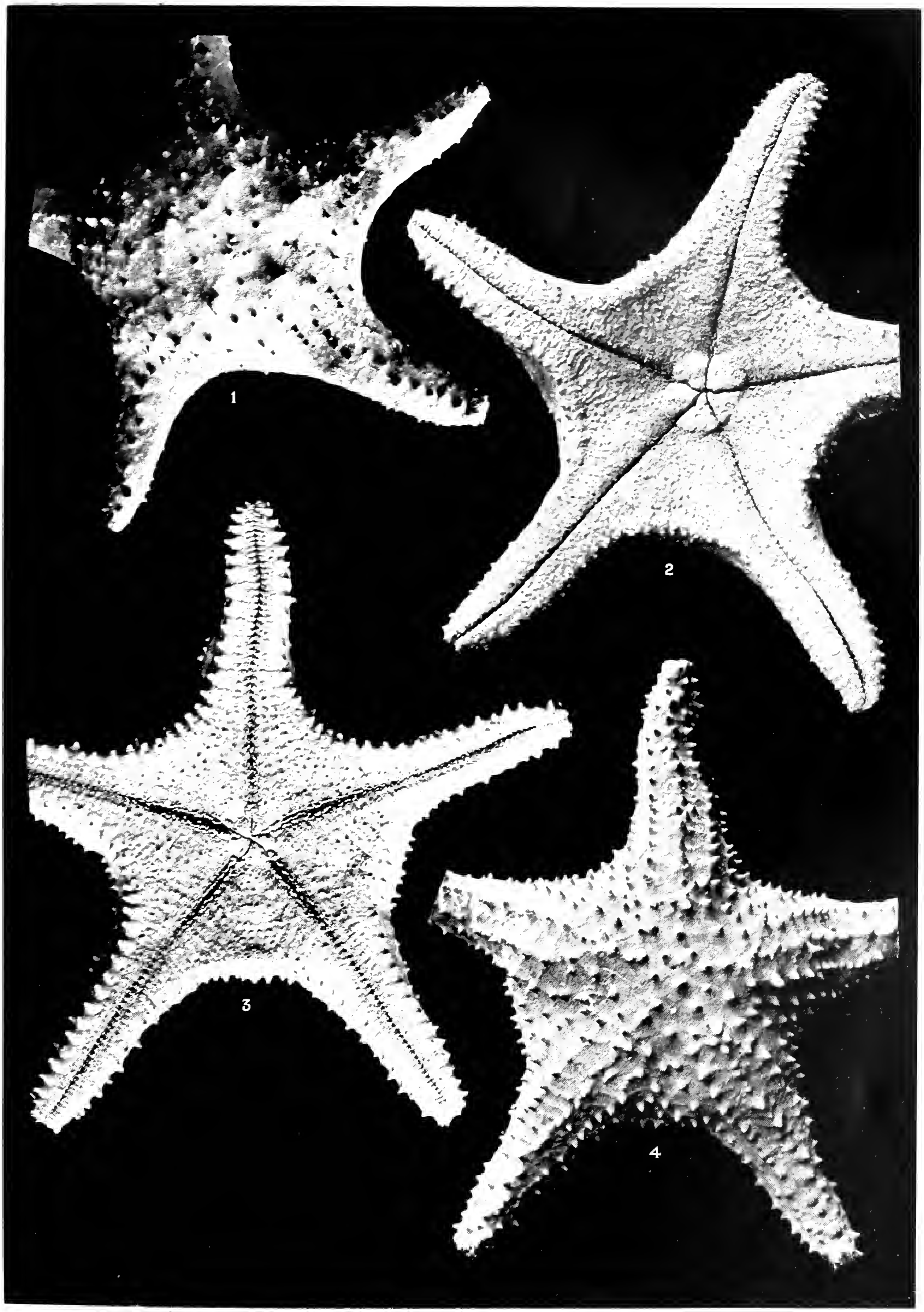
DESCRIPTION OF PLATE VII.

Fig. 1.—*Oreaster australis,* Lütken. Abactinal view of specimen from 18 miles S.W. by S. of Lady Elliot Island, Queensland. Collected by F.I.S. "Endeavour" and identified by Dr. H. L. Clark (Austr. Mus. Coll.) (R. = 120 mm.). (× 2.)

Fig. 2.—*Oreaster australis,* Lütken. Actinal view of above specimen (R. = 120 mm.). (× 2.)

Fig. 3.—*Oreaster australis,* Lütken. Actinal view of another specimen collected by the "Endeavour" in the same locality as the above specimen and identified by Dr. H. L. Clark (Austr. Mus. Coll.) (R. = 125 mm.). (× 2.)

Fig. 4.—*Oreaster australis,* Lütken. Abactinal view of above specimen (R. = 125 mm.). (× 2.)



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE VIII.

FIG. 1.—*Metrodira subulata*, Gray. R. = 35 mm. Actinal view. (× 4.)

FIG. 2.—*Astropecten granulatus*, M. and Tr. R. = 38 mm. Abactinal view. (Slightly over half nat. size.)

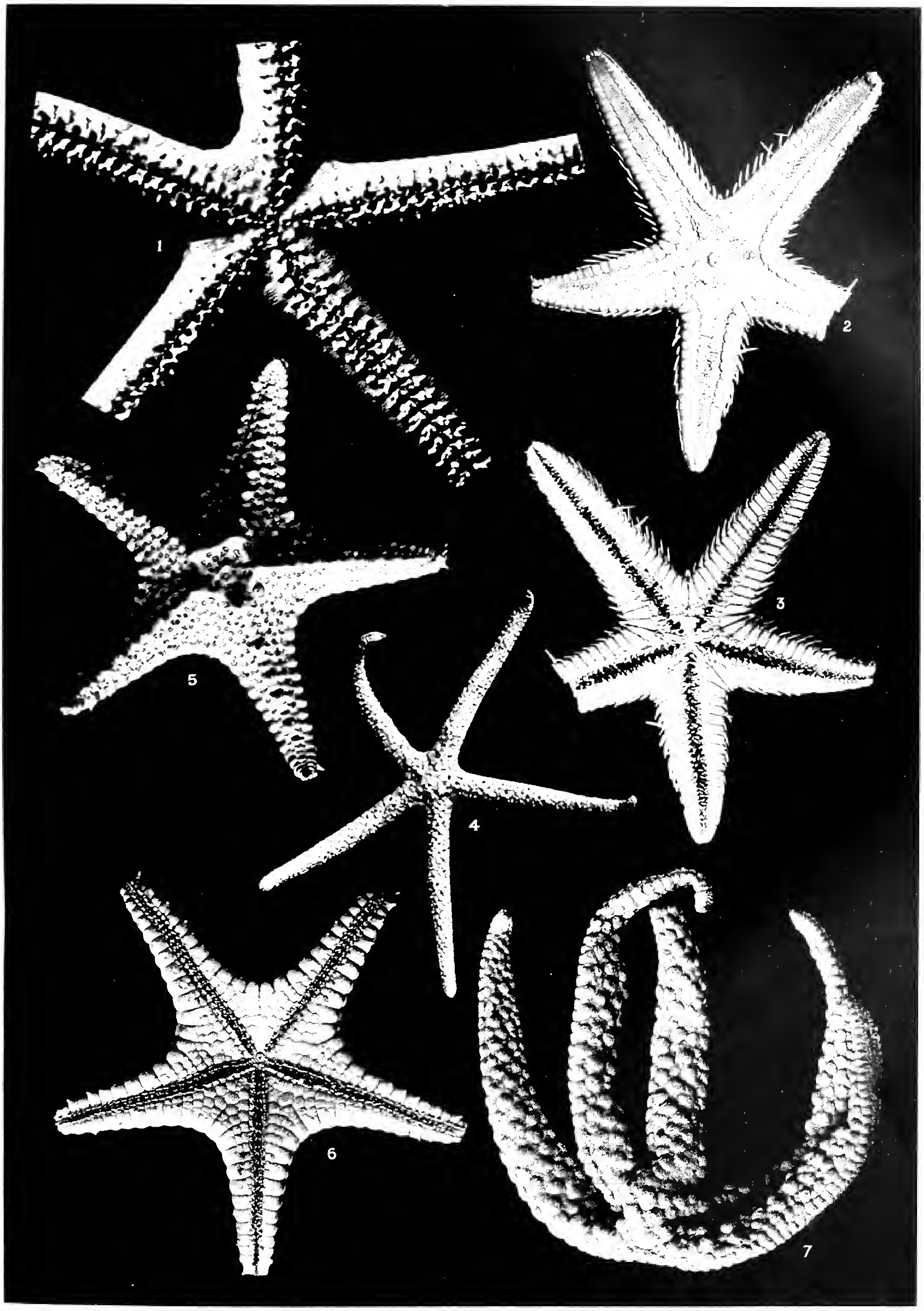
FIG. 3.—*Astropecten granulatus*, M. and Tr. Actinal view of above specimen. (Slightly over half nat. size.)

FIG. 4.—*Metrodira subulata*, Gray. Abactinal view (R. = 35 mm.). (Slightly over nat. size.)

FIG. 5.—*Oreaster australis*, Lütken. Abactinal view of largest juvenile specimen (R. = 33·5 mm.). (Slightly over nat. size.)

FIG. 6.—*Oreaster australis*, Lütken. Actinal view of above specimen (R. = 33·5 mm.). (Slightly over nat. size.)

FIG. 7.—*Nardoa rosea*, H. L. Clark. Abactinal view. Alternating large and small superomarginals seen best on second ray from left (R. = 72 mm.). (About nat. size.)



[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE IX.

Fig. 1.—*Tamaria megaloplax* (Bell). Portion of abactinal surface of ray of Bell's Albany Island specimen collected by the "Alert." Specimen now regarded as holotype (Brit. Mus. Coll.). (× 4.)

Fig. 2.—*Tamaria megaloplax* (Bell). Portion of actinal surface of ray of holotype. (× 4.)

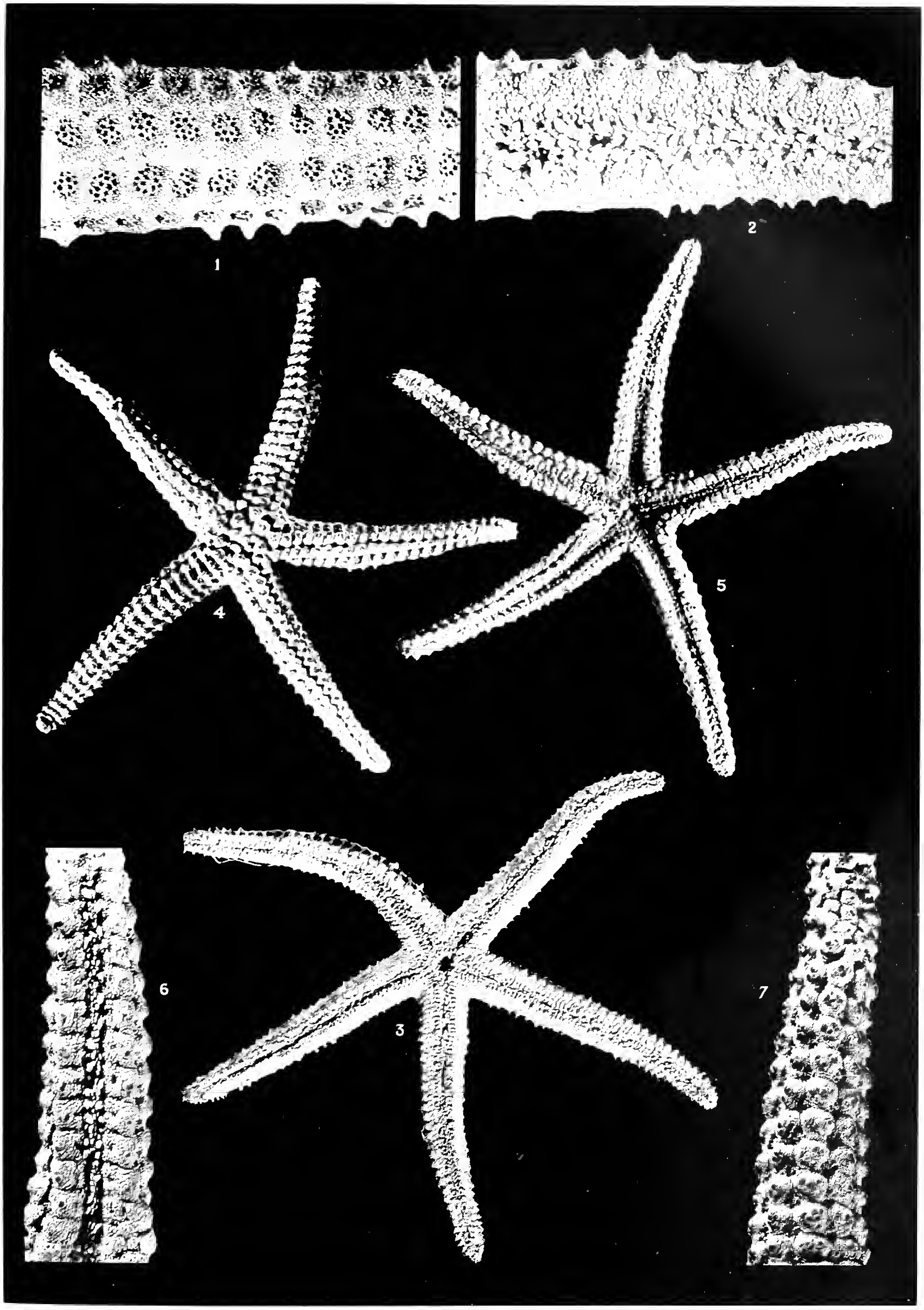
Fig. 3.—*Tamaria megaloplax* (Bell). Actinal view of Bell's Albany Island specimen, the holotype. (Nat. size.)

Fig. 4.—*Tamaria fusca*, Gray. Abactinal view of Gray's holotype (Brit. Mus. Coll.). (× $1\frac{1}{2}$.)

Fig. 5.—*Tamaria fusca*, Gray. Actinal view of Gray's holotype. (× $1\frac{1}{2}$.)

Fig. 6.—*Tamaria fusca*, Gray. Portion of actinal surface of ray of Gray's holotype. (× 4.)

Fig. 7.—*Tamaria fusca*, Gray. Portion of abactinal surface of ray of Gray's holotype. (× 4.)



[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE X.

FIG. 1.—*Oreaster australis*, Lütken. Abactinal view of old adult specimen (R. = 111 mm.). (Slightly over half nat. size.)

FIG. 2.—*Oreaster australis*, Lütken. Abactinal view of smallest young adult specimen (R. = 78 mm.). (Slightly under nat. size.)

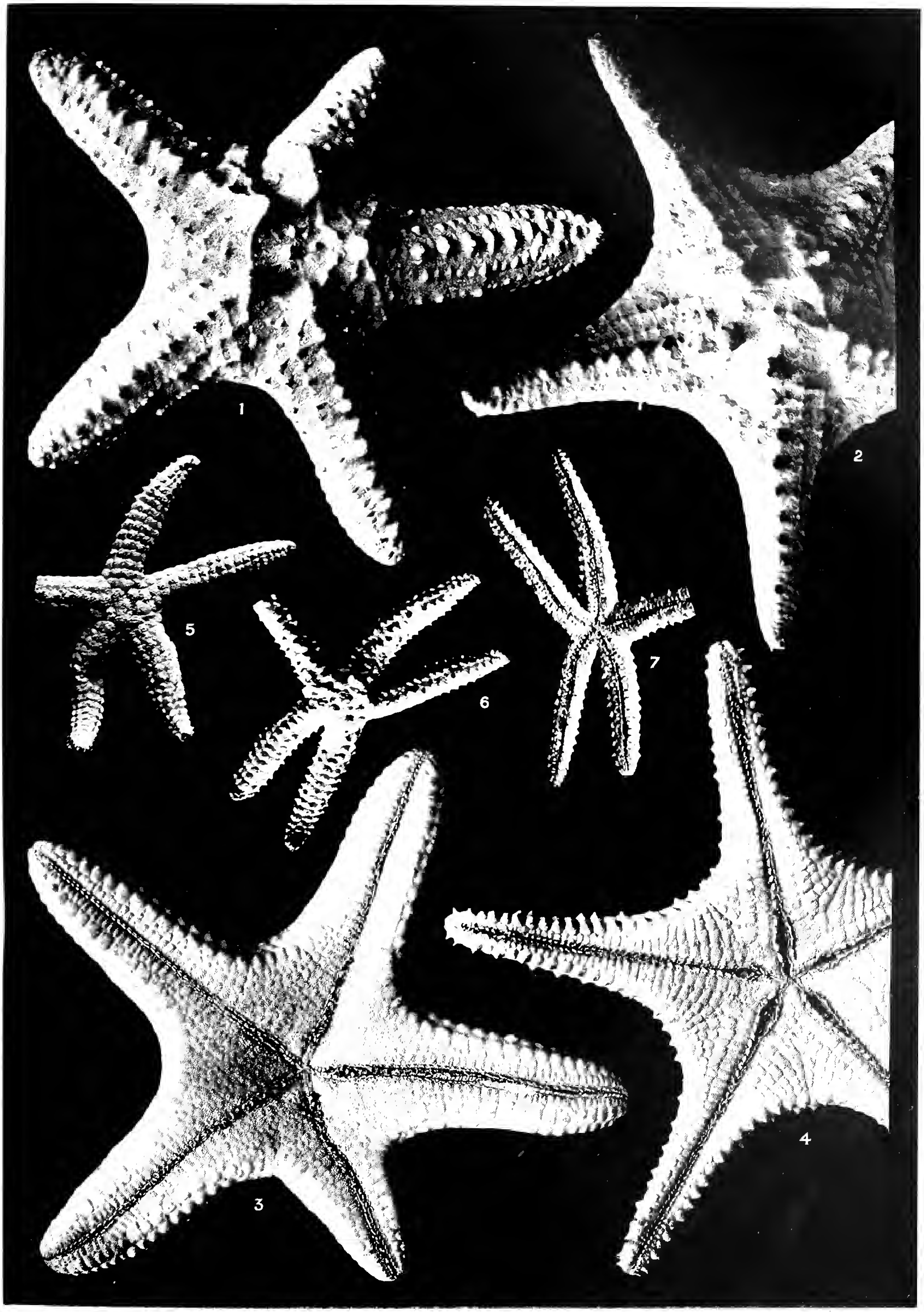
FIG. 3.—*Oreaster australis*, Lütken. Actinal view of old adult specimen (R. = 111 mm.). (Slightly over half nat. size.)

FIG. 4.—*Oreaster australis*, Lütken. Largest young adult specimen (R. = 91 mm.). (About two-thirds nat. size.)

FIG. 5.—*Tamaria hirsuta* (Koehler). Abactinal view of one of Studer's "Gazelle" specimens from north-west Australia which he identified as *O. fuscus*, Gray. It was also referred to by H. L. Clark under the name of *Tamaria fusca*, Gray (R. = about 21 mm.) (Mus. Comp. Zool. Coll.). (About $\times 1\frac{1}{2}$.)

FIG. 6.—*Tamaria hirsuta* (Koehler). Abactinal view of an Australian Museum specimen from Western Australia which is identical with the "Gazelle" series (R. = 26 mm.). (Slightly over nat. size.)

FIG. 7.—*Tamaria hirsuta* (Koehler). Actinal view of same specimen (R. = 26 mm.). (Slightly over nat. size.)



Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE XI.

FIG. 1.—*Tamaria fusca*, Gray. Actinal view of juvenile specimen from Station XIV (R. = 7 mm.). (About × 4.)

FIG. 2.—*Tamaria fusca*, Gray. Abactinal view of same specimen. (About × 4.)

FIG. 3.—*Tamaria fusca*, Gray. Abactinal view of specimen from Station XVI showing the developing characters of the adult (R. = 15·5 mm.). (Slightly over × 2.)

FIG. 4.—*Tamaria fusca*, Gray. Actinal view of same specimen. (Slightly over × 2.)

FIG. 5.—*Tamaria*, sp. ?. Actinal view of specimen from Port Curtis, Queensland (Austr. Mus. Coll.) (R. = 103·5 mm.). (About two-thirds nat. size.)

FIG. 6.—*Tamaria*, sp. ?. Abactinal view of same specimen. (About two-thirds nat. size.)

FIG. 7.—*Tamaria*, sp. ?. (? *Linckia marmorata*, Simpson and Rudmose-Brown [*non* Mich.] [in part]). Actinal view of a specimen from Zanzibar in the British Museum (Natural History), and labelled by Bell " *Ophidiaster fuscus*." (Nat. size.)

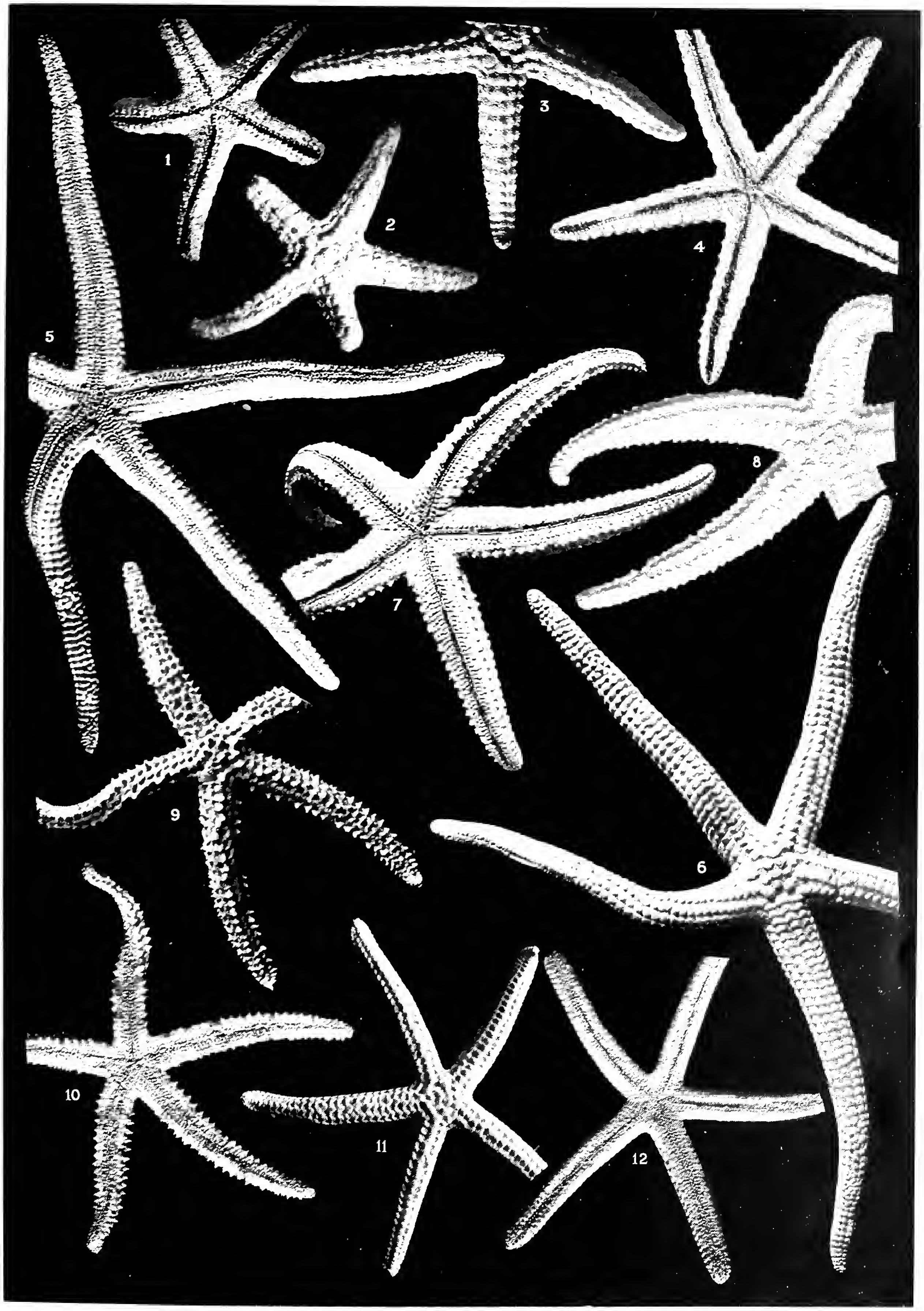
FIG. 8.—*Tamaria*, sp. ?. Abactinal view of same specimen. (Nat. size.)

FIG. 9.—*Tamaria hirsuta* (Koehler). Abactinal view of specimen from Holothuria Bank (Mus. Comp. Zool. Coll.), labelled by Bell as " *Linckia megaloplax*," and referred to by H. L. Clark under *Tamaria fusca*, Gray (R. = 44 mm.). (Slightly under nat. size.)

FIG. 10.—*Tamaria hirsuta* (Koehler). Actinal view of same specimen. (Slightly under nat. size.)

FIG. 11.—*Tamaria*, sp. ?. Abactinal view of specimen from Port Curtis, Queensland (Austr. Mus. Coll.) (R. = 34 mm.). (About nat. size.)

FIG. 12.—*Tamaria*, sp. ?. Actinal view of same specimen. (About nat. size.)



[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE XII.

FIG. 1.—*Tamaria fusca*, Gray. Abactinal view of portion of ray. Specimen from Station XIV (R. = 7 mm.). (× 15.)

FIG. 2.—*Tamaria ornata* (Koehler). Abactinal view of portion of ray. Specimen was labelled by Bell as *megaloplax*, and reduced to the synonymy of *fusca* by H. L. Clark (1921). Specimen from Holothuria Bank (R. = 22 mm.) (Mus. Comp. Zool. Coll.). (× 7.)

FIG. 3.—*Tamaria*, sp. ?. Portion of abactinal surface of ray of specimen from Port Curtis, Queensland (R. = 34 mm.). (× 10.)

FIG. 4.—*Tamaria*, sp. ? (? *Linckia marmorata*, Simpson and Rudmose-Brown [*non* Mich.] [in part]). Portion of actinal surface of ray of specimen from Zanzibar in the British Museum (Nat. Hist.), and labelled by Bell as " *Ophidiaster fuscus*." (× 4.)

FIG. 5.—*Ophidiaster propinquus*, sp. nov. Actinal view of holotype (R. = 26·5 mm.). (× $1\frac{1}{2}$.)

FIG. 6.—*Tamaria*, sp. ?. Same specimen as fig. 4. Portion of abactinal surface. (× 4.)

FIG. 7.—*Tamaria fusca*, Gray. Actinal view of specimen from Port Denison, Queensland (R. = 30·5 mm.). (Austr. Mus. Coll.). (Slightly over nat. size.)

FIG. 8.—*Tamaria megaloplax* (Bell). Abactinal view of Bell's " Alert " Albany Island specimen. Specimen regarded as holotype. (Brit. Mus. Coll.). (Nat. size.)

FIG. 9.—*Tamaria*, sp. ?. Abactinal view of specimen from Fitzroy Island, Queensland, 12 fathoms (Austr. Mus. Coll.) (R. = 29 mm.). (Slightly over nat. size.)

FIG. 10.—*Tamaria fusca*, Gray. Portion of abactinal surface of disc and ray of specimen from Station XVI (R. = 15·5 mm.). (× 6.)

FIG. 11.—*Ophidiaster propinquus*, sp. nov. Abactinal view of holotype (R. = 26·5 mm.). (× $1\frac{1}{2}$.)

FIG. 12.—*Tamaria megaloplax* (Bell). Abactinal view of specimen from Station XXII (R. = 31·5 mm.). (Slightly under × $1\frac{1}{2}$.)

FIG. 13.—*Tamaria*, sp. ?. Same specimen as fig. 9. Actinal view. (Slightly over nat. size.)

FIG. 14.—*Tamaria megaloplax* (Bell). Same specimen as fig. 12. Actinal view. (Slightly under × $1\frac{1}{2}$.)

FIG. 15.—*Tamaria fusca*, Gray. Same specimen as fig. 7. Abactinal view. (Slightly over nat. size.)

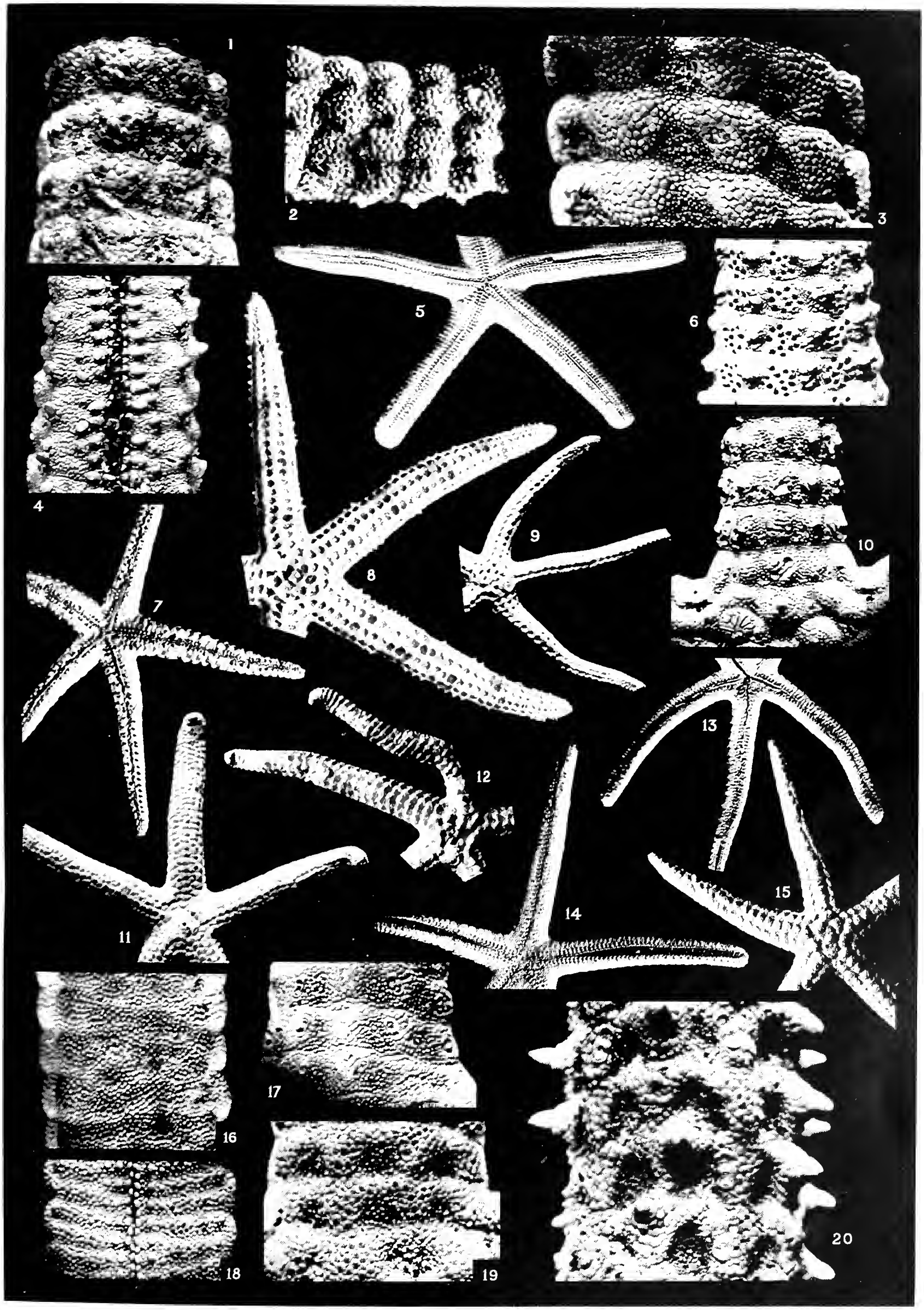
FIG. 16.—*Ophidiaster propinquus*, sp. nov. Granulation of abactinal surface of ray of holotype (R. = 26·5 mm.). (× 7.)

FIG. 17.—*Tamaria fusca*, Gray. Granulation of abactinal surface of ray. Same specimen as figs. 7 and 15. (About × 6.)

FIG. 18.—*Ophidiaster propinquus*, sp. nov. Granulation of actinal surface of ray of holotype. (About × 7.)

FIG. 19.—*Tamaria fusca*, Gray. Portion of abactinal surface of ray and disc. Same specimen as figs. 7 and 15. (About × 6.)

FIG. 20.—*Tamaria hirsuta* (Koehler). Portion of abactinal surface of ray of Holothuria Bank specimen labelled by Bell as " *Linckia megaloplax* " and referred to by H. L. Clark (1921) under *T. fusca* (Mus. Comp. Zool. Coll.) (R. = 44 mm.). (× 7.)



Adlard & Son, Ltd., Impr.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 9

FISHES

BY

GILBERT PERCY WHITLEY
Ichthyologist, The Australian Museum, Sydney

(By permission of the Trustees of the Australian Museum)

WITH FIVE TEXT-FIGURES AND FOUR PLATES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. Quaritch, Ltd., 11 Grafton Street, New Bond Street, London, W.1; Dulau & Co., Ltd., 32 Old Bond Street, London, W.1; Oxford University Press, Warwick Square, London, E.C.4
AND AT
The British Museum (Natural History), Cromwell Road, London, S.W.7
1932

Price Five Shillings

[*Issued 27th February, 1932*]

Made and printed in Great Britain.

FISHES

BY

GILBERT PERCY WHITLEY,
Ichthyologist, The Australian Museum, Sydney

(By permission of the Trustees of the Australian Museum)

WITH FIVE TEXT-FIGURES AND FOUR PLATES

INTRODUCTION.

A CHECK-LIST of the fishes of Queensland, Australia, was published by McCulloch and Whitley in 1925 (Mem. Qd. Mus., VIII, p. 125), and in a recent paper (Mem. Qd. Mus. X, 1930, p. 8) I have brought the list as up-to-date as possible. The present contribution to Queensland ichthyology arises from the basis provided by those papers, and by McCulloch's "Check-List" (Mem. Aust. Mus. V, 1929) which should be studied in connection with this Report.

The specimens discussed in the following pages were obtained at Low Isles or Batt Reef, North Queensland, under the auspices of the Great Barrier Reef Expedition, being mostly collected by the author. To various members of the Expedition and to Mr. W. Boardman of the Australian Museum are due thanks for collaboration in making this collection. Over 350 specimens of fishes were secured, and these are here referred to nearly a hundred species. The greater part of this collection will be consigned to the British Museum (Natural History). Details of the synonymy of well-known species have not been tabulated in order to save space, and only specially relevant references to literature have been included. I have tried to lighten the burden of synonymy in the papers quoted above and in my recent papers in the Records of the Australian Museum and the Australian Zoologist.

It is customary, in a report of this kind, to give a list of species, followed by tabulated symbols indicating their geographical or bathymetrical distribution. Whilst this has been attempted, it has not been considered worthy of publication, as the range of the

fishes of the Indo-Australian and Pacific regions is still not sufficiently analysed for such a synthesis to be made. The Low Isles fishes are typically Solanderian forms.* Some of the species mentioned here are newly recorded from Queensland or even Australia, and it is still easy for any Australian collector to add new species to our knowledge from the superabundant fish-fauna of Queensland and other northern Australian waters.

Acknowledgments are gladly tendered to the leader and members of the Great Barrier Reef Expedition for facilities afforded for collecting, observing, and finally reporting on the fishes of Low Isles and vicinity. To my colleague, Mr. William Boardman, who accompanied me to Low Isles as a guest of the Expedition, I am indebted for photographs of various species of fishes in their natural environment and for much help in collecting them. Mr. H. A. Longman, Director of the Queensland Museum, and Mr. J. Shewan, Curator of the Macleay Museum, University of Sydney, kindly lent typical or unique specimens of fishes from the collections in their care for study and comparison with the Low Isles series. The half-tone illustrations for this paper have been kindly prepared by Miss Joyce K. Allan. The black and white drawings are the work of the writer.

HISTORICAL.

Low Isles had apparently been visited by but few collectors prior to 1928.

Huxley and Macgillivray, of the "Rattlesnake," were the first naturalists to land at Low Isles, in 1848. John Macgillivray (Narr. Voy. Rattlesnake, I, 1852, pp. 101–103) remarked: "On July 7th [1848] we anchored to leeward of the Low Isles . . . Many kinds of fishes, *Muraena*, *Diodon*, *Balistes*, *Serranus*, etc., are found in the pools among the coral blocks."

Sir William Macleay in the "Chevert" visited Low Isles, but authors of papers on the Queensland marine fauna have wrongly recorded his specimens from Torres Strait. That the "Chevert" was at the Low Isles off Port Douglas is evident from contemporary accounts which I have consulted in the Mitchell Library, Sydney. Macleay himself wrote in one of these (Sydney Morning Herald, 16th October, 1875, p. 487):

> "On the next day [June 6th, 1875] we anchored early off a low wooded sand-bank, marked on the chart "Low Wooded Isle." It was surrounded by an extensive coral reef . . . the whole reef was literally teeming with life—fish in great variety, Crustacea, Echinoderms including several species of beche-de-mer, corals and annelids."

Some fishes were collected by members of the "Chevert" Expedition, and the various species were recorded from Low Isles by Alleyne and Macleay in the early part of the Proceedings of the Linnean Society of New South Wales.

A series of Low Isles fishes was obtained by my late friend, W. E. J. Paradice, in 1923, when he was Surgeon-Lieutenant on H.M.A.S. "Geranium." These specimens are preserved in the Australian Museum and have been recorded in this report.

Non-technical accounts of some of the fishes of the British Great Barrier Reef Expedition have been given by Tandy in Natural History Magazine, II, 1929, by Whitley and Boardman in The Australian Museum Magazine, III, 1929, and by Yonge (A Year on the Great Barrier Reef, published 10th November, 1930).

* Hedley, Proc. Linn. Soc. N.S.W. XXVIII, 1903 (published 28th April, 1904), p. 880.

SYSTEMATIC ACCOUNT.

Family HEMISCYLLIIDAE.

Genus *Hemiscyllium*, Müller and Henle, 1838.

Hemiscyllium ocellatum (Bonnaterre).

This species is very common in shallow waters of the Great Barrier Reef and was one of the first fishes to be described from what is now Queensland. It was occasionally met with under boulders on the reef flat near Madrepore Moat, Low Isles. One specimen preserved; Australian Museum registered number IA.4485. A 3-ft. specimen captured among mangrove (*Rhizophora*) roots had the right ocellus normal, but the left was a mere irregularly defined blackish area.

Family DASYATIDAE.

Genus *Taeniura*, Müller and Henle, 1837.

Taeniura lymnia halgani (Lesson).

Taeniura lymnia halgani, Whitley, Rec. Aust. Mus. XVIII, 25th March, 1931, p. 97, pl. xi (references and synonymy).

The commonest Sting Ray at Low Isles. One specimen caught at Batt Reef had eaten prawns, mantis shrimps and polychaete worms.

Genus *Himantura*, Müller and Henle, 1837.

Himantura granulata (Macleay).

(Plate I, fig. 1).

A specimen seen amongst mangrove roots (28th August). It lay motionless on the mud, and was difficult to distinguish from its shadowy surroundings. Others were seen at different times, showing that this species, which had not at that time been recorded from Australia, was fairly common at Low Isles.

A fine specimen (IA.4477) was caught in a creek amongst mangroves on 19th September, 1928. This agrees well with my account of *Himantura granulata* (Rec. Aust. Mus. XVI, 1928, p. 211, figs. 1, 2), but the ventral surface has series of brownish blotches disposed in roughly symmetrical rows on each side, as well as broad brownish-grey margins. Sex—female; stomach contained small crabs and prawns.

COLOURS WHEN FRESH.—Dark olive-greyish on back, with a few scattered white spots, not forming ocelli or marks like those in Jordan and Seale's figure of *Himantura fai*. Pupil black, enclosed in a whitish ring and surrounded by smoky grey; the eye is outlined with blackish, and has a light grey "eyelid" which does not form a flap.

The eyes protrude laterally. In my figure of a long-preserved specimen they are

represented as sunken in the sockets. The wrinkles around the mouth are probably also largely the result of methods of preservation.

Family STOLEPHORIDAE.

Genus *Stolephorus*, Lacepède, 1803.

Stolephorus robustus (Ogilby).

Three young specimens (IA.4470), tow-netted at night, September, 1928, are apparently referable to this species.

Family CLUPEIDAE.

Genus *Harengula*, Cuvier and Valenciennes, 1847.

Harengula punctata (Rüppell).

One (IA.4459) in the Australian Museum from Low Isles, 30th September, 1928, compared with three (I.4581) in the Queensland Museum from the same locality.

Clupea profundis, *C. ranelayi* and *C. torresiensis*, Saville-Kent, may be relegated to the synonymy of this species. All these are *nomina nuda* taken from the manuscripts of De Vis; they were also listed in Saville-Kent's The Great Barrier Reef of Australia, p. 370.

The type of *C. ranelayi* is 31 mm. long, and is preserved in the Queensland Museum. Specimens labelled *C. torresiensis* are in the Queensland and Australian Museums. The type of *C. profunda* (*sic*) is in the Australian Museum.

Family OPHICHTHIIDAE.

Genus *Zonophichthus*, Whitley, 1930.

Zonophichthus marginatus (Bleeker).

One (IA.4491) from Low Isles agrees with Bleeker's figure of *Ophichthys cephalozona;* I have not seen Bleeker's original description of *Muraenopsis marginatus*, but do not regard it as invalidated by *Ophisurus marginatus* Peters, as the two species are evidently not congeneric.

LIFE COLOURS.—General colour greyish brown, darkest dorsally; dirty white ventrally. A whitish band across the nape is followed by a prominent, broad, saddle-shaped band of very dark brown, and this is bordered posteriorly by another whitish band which encircles the fish at the pectorals and a little before the dorsal. Pupil black, rest of eye olivaceous. The rims of the mucus-pores on the head and body are brown. Dorsal greyish near base, becoming darker inframarginally, but bordered by strongly contrasted white. Anal similar to dorsal. End of tail fading to whitish with the extreme tip pink.

Vent and genital aperture brownish. Pectoral yellow, with a white border, darker on its inner surface.

Occasionally seen swimming in shallow water over coral in reef flat.

Family Muraenidae.

Genus *Echidna*, Forster, 1788.

Echidna nebulosa (Thunberg).

One (IA.4087) from Low Isles under stone, 15th September; two (IA.4088) from Snapper Island and one old specimen (IA.4058) from Batt Reef. Deraniyagala has erroneously included "South Australia" in the range of this common tropical species, but it is doubtful whether it crosses the border of Queensland and New South Wales. An ancient figure, which seems to represent this species, has been given by Valentyn (Amboina, III, 1726, p. 460, fig. 364).

Genus *Gymnothorax*, Bloch, 1795.

Gymnothorax cancellatus (Richardson).

Muraena cancellata, Richardson, Zool. Voy. "Erebus" and "Terror," Fish, 1848, p. 87, pl. xlvi, figs. 1–5. West Australia (type-loc.); Cape Upstart, Queensland; and Sumatra. Types in British Museum.
Thyrsoidea cancellata, Kaup, Cat. Apodal Fish Brit. Mus. 1856, p. 76, fig 59 (type).
Gymnothorax cancellatus, Bleeker, Atlas Ichth. IV, 1864, p. 93, pl. clxxv, fig. 3 (East Indies).
Muraena cancellata, Macleay, Proc. Linn. Soc. N.S.W. VIII, 1883, p. 278 (Hood Bay, New Guinea).

One specimen from Low Isles (IA.4056).

Weber and Beaufort regard this form as identical with *Gymnothorax undulatus* (Lacepède), but, as my specimen agrees better with the figures of Richardson and Bleeker, I am using the name *cancellatus* for it. The colours of the Western Australian typical form are more diffuse than in the Queensland specimen, but it seems inadvisable to give a new name to the latter. Fowler (Mem. Bishop Mus. X, 1928, pp. 56, 57) has given a long list of nominal synonyms of *Lycodontis* (= *Gymnothorax*) *undulata* (Lacepède).

Gymnothorax melanospilos (Bleeker).

One specimen (IA.4052) from Low Isles, whose head has been figured in the Aust. Mus. Mag. iv, 1930, p. 98.

Life Colours.—Ground-colour light greenish grey on back, sides, and dorsal fin; lighter and suffused with pinkish below. Top of head dark greenish; chin brown. A number of irregular dark brown spots on head, body, and dorsal fin. Anal whitish. Eye blue, with a coppery ring; iris greyish. Grooves on throat brown. Jaws white; rictus dark brown. Inner parts of mouth brown.

Genus *Anarchias*, Jordan and Seale, 1906.

Anarchias, Jordan and Seale, Bull. U.S. Bur. Fish XXV, 1905 (1906), p. 204.

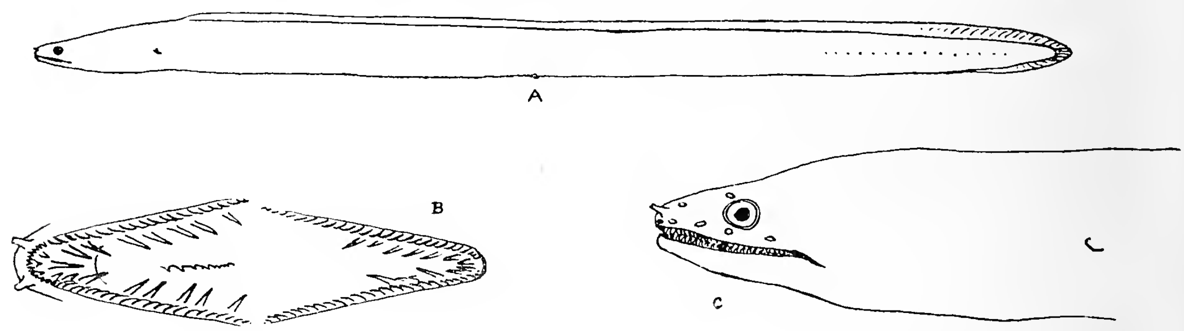
This genus, whose name must not be confused with the variants of *Anarhichas*,

Linnaeus, is distinguished from *Gymnothorax* by having the anal fin atrophied anteriorly. It has not before been recognized from Australia, having been recorded only from Samoa and the Philippine Islands. There is, however, a New Hebrides specimen of *A. knighti*, Jordan and Seale, in the Australian Museum, so that the range of the genus is now considerably extended.

Anarchias insuetus, sp. n.

Head (21·5 mm.) 8·6, depth (9) about 20 in total length (185). Interorbital subequal to eye (2), 1·5 in snout (3). Gape (8) 2·7 in head. Head and body (90) shorter than tail (95).

Profile of head oblique. Snout rounded. Upper jaw slightly longer than lower. Eye small, round, enveloped in skin. Anterior nostrils in the form of short tapering tubes. Posterior nostrils circular, without an elevated rim.



TEXT-FIG. 1.—*Anarchias insuetus*, sp. n. Holotype from Low Isles. Regd. no. IA.4458. A. The entire specimen. B. Dentition (enlarged). C. Head (enlarged). Drawings by Gilbert P. Whitley.

Four large subelliptical pores along the margin of the upper jaw. Two similar pores on the interorbital, one over the anterior half of each eye. Gill openings small, lateral, rising obliquely upward and forward.

Gape large, extending almost as much behind the eye as it does before it. All the teeth are more or less movable. A single series of small hinged inter-maxillary teeth with a small mesial tooth and a large depressible fang on the intermaxillary plate. An outer row of short, curved, pointed teeth in a single series on each maxillary, flanked by an inner row of about seven long, depressible fangs. A single series of about seven depressible teeth on the vomer, which forms a ridge. Mandible with an outer row of close-set, curved teeth and a group of fang-like teeth behind the symphysis. Several depressible fangs, on each side of the mandible, inside the outer row of smaller teeth. These were probably originally symmetrical, but some small recumbent teeth in the present example suggest that replacement of broken ones is taking place.

General form of body elongate, rather compressed. The trunk is three times the length of the head, and the tail is longer than the head and trunk combined. Integument smooth, tough. Lateral line with small, spaced pores. Dorsal fin originating a short distance behind head and continuing as a low, fleshy fold to the tip of the tail, where it is indistinguishable externally from the minute caudal fin. Anal fin atrophied anteriorly, appearing as a low fold posteriorly, where it joins the caudal in a similar manner to the

posterior portion of the dorsal fin. Weak fin-rays can only be discerned around the tip of the tail.

General colour, in alcohol, dark olive brown, becoming tinged in places with yellowish, especially on the lower part of the head and body, and becoming still lighter on the lips. Dorsal, caudal, and anal blackish. No spots. No black mark around gill-openings.

Described and figured from the holotype, a somewhat shrivelled specimen, 185 mm. long, from Low Isles, off Port Douglas, Queensland.

Australian Museum registered number IA.4458.

This new species appears to differ from its congeners in the shape of the head, the disposition of its teeth, and in having a fairly uniform coloration.

Genus *Siderea*, Kaup, 1856.

Siderea picta (Thunberg).

One large specimen (IA.4489) from the reef flat at Low Isles agrees with Weber and Beaufort's fig. 183c (Fish. Indo-Austral. Arch. III, 1916). This species was commonly seen swimming over coral; it generally leaned to one side and kept the mouth wide open, and is probably the kind of which MacGillivray (Narr. Voy. Rattlesnake, I, 1852, p. 102) had such unpleasant experience.

Genus *Uropterygius*, Rüppell, 1838.

Uropterygius marmoratus (Lacepède)

One (IA.4490) from Low Isles: wriggling, head or tail first, amongst coral debris. A common Indo-Pacific species not hitherto noticed from Queensland.

LIFE COLOURS.—Ground-colour creamy white, almost covered by light and dark brown blotches which are more densely crowded near the dorsal surface. Dorsal and anal fins imperceptible, even the tip of the tail being fleshy. Vent dark bluish. Pupil black, surrounded by a coppery ring; iris light violet.

Family FISTULARIIDAE.

Genus *Fistularia*, Linnaeus, 1758.

Fistularia petimba, Lacepède.

A specimen seen early one morning inshore changed colour, when disturbed by a nearby school of fishes, from uniform cigar-brown to sandy-coloured bars alternating with dark brown bands irregularly broken by lighter.

I have examined a specimen from Low Isles in the Queensland Museum, Brisbane.

Family SYNGNATHIDAE.

Genus *Hippichthys*, Bleeker, 1849.

Hippichthys, Bleeker, Verh. Batavia Genoot. XXII, 1849 (Ichth. Faun. Madura), p. 15. Genotype, *H. heptagonus*, Blkr.

? *Corythoichthys*, Kaup, Archiv Naturgesch. (Wiegmann), XIX, 1, 1853, p. 231; Cat. Lophobr. Fish Brit. Mus. 1856, p. 25. Genotype, *C. albirostris*, Kaup, selected by Jordan and Evermann, Rept. U.S. Comm. Fish 1895 (28th December, 1896), appendix 5, p. 328, where the name is spelt *Corythroichthys*.

Corythoichthys, Duncker, In Michaelsen and Hartmeyer, Faun. S.W. Austr. Bd. II, lief. 15, 1909 p. 237; Jahrb. Hamburg Wiss. Anst. XXIX, 1912, p 232. *Non sensu stricto.* Genotype regarded by Duncker as *Syngnathus conspicillatus* Jenyns.

In diagnosing *Hippichthys*, Bleeker remarked that it had no anal fin. This fin is minute and sometimes difficult to see in species of the genus called *Corythoichthys* by writers on Indo-Pacific Syngnathidae, and as, apart from this discrepancy, Bleeker's description applies to the Pipe-fishes described below, his generic name may be employed.

Subgenus *Bhanotichthys*, Parr, 1930.

Bhanotichthys, Parr, Bull. Bingham Oceanogr. Coll. III, 1930. Genotype, *Syngnathus fasciatus*, Gray.

Hippichthys (*Bhanotichthys*) *intestinalis* (Ramsay).

Syngnat(h)us intestinalis, Ramsay, Proc. Linn. Soc. N.S.W. V, 20th May 1881, p. 494. No locality (= Duke of York Island and Bougainville I., Solomons). Types in Austr. Mus., Sydney, examined; Boulenger, Cambr. Nat. Hist. 1904, p. 635.

Corythroichthys waitei, McCulloch, Abstr. Proc. Linn. Soc. N.S.W., No. 285, July, 1910 (Cairns Reef, off Cooktown, Queensland).

Corythroichthys intestinalis, McCulloch, Zool. Res. "Endeavour," I, 1911, p. 26; Ogilby, Mem. Qd. Mus. II, 1913, p. 90.

? *Corythoichthys fasciatus*, Duncker and Mohr, Mitt. Zool. Mus. Hamburg, XLI, 1925, p. 108 (New Guinea, New Mecklenburg, New Pomerania). Not *Syngnathus fasciatus*, Gray, Illust. Indian Zool. I, October, 1830, pl. lxxxix, preoccupied by *S. fasciatus*, Risso, Ichthyol. Nice, 1810, p. 70.

Corythoichthys flavofasciatus, Fowler, Mem. Bishop Mus. X, 1928, p. 113 (Pacific localities); McCulloch, Mem. Aust. Mus. V, 1929, p. 87. Not *Syngnathus flavofasciatus*, Rüppell, Neue Wirbelth. Abyssin. Fische, 1838, p. 144.

D. 28; A. 2; P. 16; C. 8. Osseous rings 16 + 33.

Head (14·5 mm.) 9·3 in total length (134). Depth (5) 6·4 in trunk (32), which is 2·4 in tail including caudal (76). Length of caudal (4) 3 in base of dorsal (12). Length of pectoral (3) equals longitudinal diameter of orbit (3), 2 in snout (6), which is a trifle longer than posterior portion of head (5·5).

Body elongate, seven-cornered in transverse section, deepest before the dorsal. Tail tapering, four-cornered in cross-section. Dorso-lateral ridges of body and tail not continuous. Lateral ridges of body ceasing on the ring before that on which the dorso-lateral ridges of the tail commence.

Ventro-lateral ridges of body and tail continuous. A weak median keel on body ventrally. Brood pouch on anterior ten tail-rings, but ventral flaps extend still farther back.

Mouth small; snout keeled above. Eyes large, with concave interorbital. A transverse keel on the operculum, which is also pitted. A pair of crests above and behind eyes; three median crests on nape. No serrations on crests.

Dorsal originating behind vertical of anus, its base not raised. Anal fin minute. Caudal with thick pointed rays.

Straw-coloured, suffused with pinkish, crossed by about seventeen patches of blackish reticulations which break into pairs posteriorly. A few blackish reticulations on head, back, and flaps of brood pouch; none on ventral surface. A short brown stripe below opercular ridge, a darker one extending along posterior half of snout, below eye, to lower

part of operculum. Several small dark brown blotches on isthmus and three larger ones on ventral surface of first three body-rings.

Described from one of three specimens. $4\frac{3}{4}$ to 5 in. long, collected at Batt Reef, Queensland, 13th September, 1928: where the species was commonly seen lying on the sand, but would wriggle into weed or under stones when disturbed. Registered Nos. IA.4059 (described specimen) and 4060 (2 specs.). Another (IA.4469) from coral in moat at Low Isles.

This species is listed from Australia as *Corythoichthys flavofasciatus*, Rüppell (McCulloch, Mem. Aust. Mus. V, 1929, p. 87), but as that is a Red Sea species, it seems doubtful whether the Australian form is conspecific. I have compared Queensland specimens with the types of *Syngnathus intestinalis*, Ramsay, in the Australian Museum, and find they agree excellently.

Corythroichthys sealei, Jordan and Seale (Seale, Occ. Pap. Bishop Mus. IV, 1, 1906, p. 17 *nom. nud.*; Jordan and Seale, Bull. U.S. Bur. Fish. XXV, 1906, p. 213, fig. 18, Apia, Samoa), has two broad blackish bands on each side of head and blotches on body not nearly so densely reticulated. Specimens of this species were collected for the Australian Museum at Pango Pango, Samoa, by Charles Hedley. *Corythroichthys waitei* of the same authors has apparently different formula and denser colour-markings.

Duncker (Jahrb. Hamburg. Wiss. Aust. XXXII, 1915, p. 72) and Weber and Beaufort (Fish. Indo-Austr. Archip. IV, 1922, p. 70, fig. 31) unite these forms with the Indian *C. fasciatus* (Gray) (a preoccupied name), whilst noting that the Pacific form has a shorter and more slender snout.

Günther (J. Mus. Godeffroy, VI, 17 [Fische Südsee, IX], 1910, p. 431, pl. clxvii, fig. c) records "*Syngnathus haematopterus*" from New South Wales, but I very much doubt whether its range extends so far southward. Probably Günther thought Ramsay's unlocalized specimen came from this State. His figure shows a fish in which the dark transverse bands are fasciated rather than reticulated as in *Hippichthys intestinalis*.

Specimens of *Hippichthys intestinalis*, 2 to $6\frac{1}{2}$ in. long, are in the Australian Museum from Cairns Reef off Cooktown, Queensland; North Coast of Guadalcanar, and Bougainville I., Solomon Islands; New Britain; Fiji; Vila and Malekula, New Hebrides; Duke of York Island (from intestine of bêche-de-mer)—types of *Syngnathus intestinalis*, Ramsay.

Genus *Doryrhamphus*, Kaup, 1853.

Doryrhamphus melanopleura (Bleeker).

One (IA.2373) collected at Low Isles by Dr. W. E. J. Paradice.

Family Belonidae.

Genus *Strongylura*, Van Hasselt, 1823.

Strongylura terebra (Whitley).

Two specimens (IA.4090–1) from Low Isles, netted by lamplight at night, 8th September, 1928.

Tylosurus sp.

Large specimens, tentatively regarded as *Tylosurus*, were seen leaping from the water between Low Isles and Batt Reef but no specimens were secured.

Family Hemiramphidae.

Genus *Farhians*, Whitley, 1930.

Farhians commersonii (Cuvier).

Esox marginatus var. b. *far*, Forskål, Descr. Anim. 1775, pp. xiii and 67, species 98, var. b. Vernacular name in a non-binomial work. Loheia, Red Sea.

Esox gladius var., Lacepède, Hist. Nat. Poiss. V, 1803, pp. 295 and 313, pl. vii, fig. 3. "Indies" (=East Indies). Type of *Hemiramphus commersonii*, Cuvier.

Hemiramphus commersonii, Cuvier, Règne Anim. ed. 2, II, April, 1829, p. 286, footnote 1. Based on Lacepède's figure (type locality, East Indies, designated by Whitley, Aust. Zool. VI, 1930, p. 250); Valenciennes, C. R. Acad. Sci. Paris, XXIII, August, 1846, p. 269; Cuvier and Valenciennes, Hist. Nat. Poiss. XIX, "1846" (= May, 1847), p. 28; ed. 2, p. 20; Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, 1877, p. 349 (Cape York, Queensland).

Hemiramphus far, Rüppell, Neue Wirbelth. Abyssin., Fische, 1837, p. 74 (Red Sea).

Hemiramphus moar, Thiollière, Ann. Agric. Soc. Lyon, VIII, 1856; Essai Faune Île Woodlark (Montrouzier), 1857, p. 205. Woodlark Island. Virtually a *nomen nudum*, regarded as equivalent to *H. far* by Fowler, Mem. Bishop Mus. X, 1928, p. 77.

Hemiramphus obesus, Castelnau, Mém. Poiss. Afr. Aust. 1861, p. 64. Port Natal, South Africa (*fide* Barnard, Ann. S. Afr. Mus. XXI, 1925, p. 262.)

Hemiramphus far, Bleeker, Atlas Ichth. VI, 1871, p. 54, pl. cclii, fig. 3, as *H. commersonii*, published 1869; Saville-Kent, Gt. Barrier Reef, 1893, pp. 299 and 370, pl. xlvii, fig. 2 (Queensland); Stead, Edible Fish, N.S. Wales, 1908, p. 37; Cockerell, Mem. Qd. Mus. II, 1913, p. 51 (scales); Boulenger, Cat. Freshw. Fish, Afr. III, 1915, p. 15, fig. 9; Weber and Beaufort, Fish. Indo-Austr. Archip. IV, 1922, p. 156, fig. 55 (references).

Farhians commersonii, Whitley, Aust. Zool. VI, 1931, p. 314 (N.S. Wales).

Three specimens caught offshore at Low Isles by Mr. F. S. Russell, using a trout fly, on 23rd August, 1928. One of these (IA.4480) is preserved in the Australian Museum, together with a specimen from the same locality (IA.1676) collected by Dr. Paradice.

Life Colours.—Back dark greenish-blue, each scale with a greyish border and some scales entirely grey. Sides of body brilliant silver with blue and green iridescence in some lights. Lateral band silvery white, margined above by a less definite blue band. Lower parts of body silvery white. Top of head greenish with peacock-blue reflections. Opercles and sides of head silvery with pink iridescence. Top of lower jaw brownish grey; its ventral surface orange, brighter towards tip, and the flaps orange margined with black. Pupil black, iris white; upper part of eye peacock green. Dorsal brilliant bluish green anteriorly, yellow tipped, and white posteriorly. Upper caudal lobe greenish with yellow tip; lower lobe blue. Pectorals, ventrals, and anal white. Axillary spot dark blue.

Taxonomy.—I have been unable to trace in literature any acceptable usage, in true binomial fashion as a scientific name, of Forskål's Arabic vernacular name *Far*, before Rüppell employed it as a specific name in 1837. Bonnaterre (Tabl. Encycl. Meth., Ichth., 1788, p. 175) and Bory de Saint Vincent (Dict. Class, d'Hist. Nat. VI, 1824, p. 311) merely used *Far* in the vernacular, and Forskål's variety was not distinguished from *Esox marginatus* in either Gmelin's (1789) or Turton's (1806) editions of the Systema Naturae of

Linnaeus. *Hemiramphus commersonii*. Cuvier, is said to be conspecific with *H. far*, Rüppell, and as Cuvier's name has priority it must be used for this species.

I have designated "East Indies" as the type-locality of *H. commersonii*. If the Red Sea form be distinct, it should be known as *Farhians far* (Rüppell).

Genus *Zenarchopterus*, Gill, 1863.

Zenarchopterus dispar (Cuv. and Val).

D.11, its fourth ray produced into a hook. A.11, the sixth ray feather-like and nearly reaching end of caudal, and the seventh ray feather-like to a much less degree. P.10. Anal papilla mammiform. Upper jaw as long as broad.

A male (IA.4467), characterized above, and two females (IA.4468) from amongst mangroves, Low Isles, where the species was commonly seen swimming about the mangrove roots or floating at the surface of the clear water. These fishes are difficult to catch, but I secured my specimens by throwing sand at them and stunning them.

A larva (IA.4474) is apparently also referable to this species: it was found swimming amongst young mullet in the moat near the mangrove park.

Genus *Arrhamphus*, Günther, 1866.

Arrhamphus sclerolepis, Günther.

One (IA.4501) from Low Isles, 2nd September, 1928.

Family Atherinidae.

Genus *Pranesus*, Whitley, 1930.

Pranesus ogilbyi, Whitley.

Atherina lacunosa, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, 1877, p. 340 (Cape York ?). Not *Atherina lacunosa*, Bloch and Schneider, Syst. Ichth. 1801, p. 112.

Atherina pinguis, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, 1877, p. 340 (Hall Sound, New Guinea). Not *Atherina pinguis*, Lacepède, Hist. Nat. Poiss. V, 1803, p. 372, pl. xi, fig. 1; Saville-Kent, Gt. Barrier Reef, 1893, pp. 293 and 370; Tosh, Parlm. Rept. Mar. Dept. Qd. 1902–3 (1903), p. 22, pl. xxii, fig. 8 (egg); Ogilby, Mem. Qd. Mus. I, 1912, pp. 37–38, pl. xii, fig. 1, and text-fig. *a*; Cockerell, Mem. Qd. Mus. II, 1913, p. 52 (scales).

Hepsetia pinguis, Jordan and Hubbs, Stud. Ichth. Monogr. Rev. Atherinidae, 1919, p. 32 (part); McCulloch and Whitley, Mem. Qd. Mus. VIII, 1925, p. 140; McCulloch, Mem. Aust. Mus. V, 1929, p. 109 (Queensland refs. only).

Pranesus ogilbyi, Whitley, Mem. Qd. Mus. X, 28th August, 1930, p. 9 (Moreton Bay, Queensland). Type in Queensland Museum.

Ogilby (1912) has given a good description of this species, of which the holotype is in the Queensland Museum.

On 29th August, 1928, the North-eastern Moat was in places densely crowded, at low water, by schools of these fishes or "Hardiheads," as they are called, which rushed madly in groups, often breaking the surface or even leaping out of the water. Sea-birds,

sometimes harrassed by Frigate Birds, preyed on them from above. The terrified fishes sought shelter near coral blocks and even beside the boots of the writer, often colliding with his legs in their panic. They were then fairly easily caught with a hand-net. Later a Blacktip Shark began to feed on the fishes. The Hardiheads were also present in September, sometimes appearing in the Madrepore Moat, over rocks in the open sea nearby, or near the Crab Spit.

On 26th September these Atherines were very thick in the moats. In one open sheet of water leading into the mangroves the writer saw what looked like the shadow of a large tree on the water, but which on closer inspection resolved itself into a roughly diamond-shaped mass of Atherines, densely packed into an area of several square yards.

Four (I.4621–4624) in the Queensland Museum and ten (IA.4335–4337) in the Australian Museum from Low Isles.

Genus *Atherina*, Linnaeus, 1758.

Atherina lacunosa, Bloch and Schneider.

Four small specimens (IA.4464) from Low Isles.

Genus *Atherion*, Jordan and Starks, 1901.

Atherion maccullochi, Jordan and Hubbs.

This genus and species, characterized by the vent being near the anal fin and the lower part of head spiny, has not hitherto been recorded from Australia. One specimen (IA.2372), "caught a few yards from shore over a clean coral sand beach" by Dr. Paradice, and two specimens (IA.4472) 27–30 mm. in standard length, from Low Isles; caught at surface at night, 4th September, 1928. These have 42–43 transverse series of body-scales and 18–20 predorsal scales, eleven dorsal and sixteen anal rays, and have been compared with Lord Howe Island topotypes in the Australian Museum. *Atherina villosa*, Duncker and Mohr (Mitt. Zool. Mus. Hamburg, XLII, 1926, p. 135, fig. 10) is apparently congeneric.

Family Melanotaeniidae.

Genus *Pseudomugil*, Kner, 1867.

Pseudomugil signatus (Günther).

Atherina signata, Günther, Ann. Mag. Nat. Hist. (3), XX, 1st July, 1867, p. 64. Cape York, Queensland (Damel). Type in British Museum; Macleay, Proc. Linn. Soc. N.S.W. VI, July, 1881, p. 40.
Pseudomugil signifer, McCulloch and Whitley, Mem. Qd. Mus. VIII, 1925, p. 140 (N. Queensland record only).
Pseudomugil signatus, Jordan and Hubbs, Stud. Ichth. Monogr. Rev. Atherinidae, 1919, p. 28.

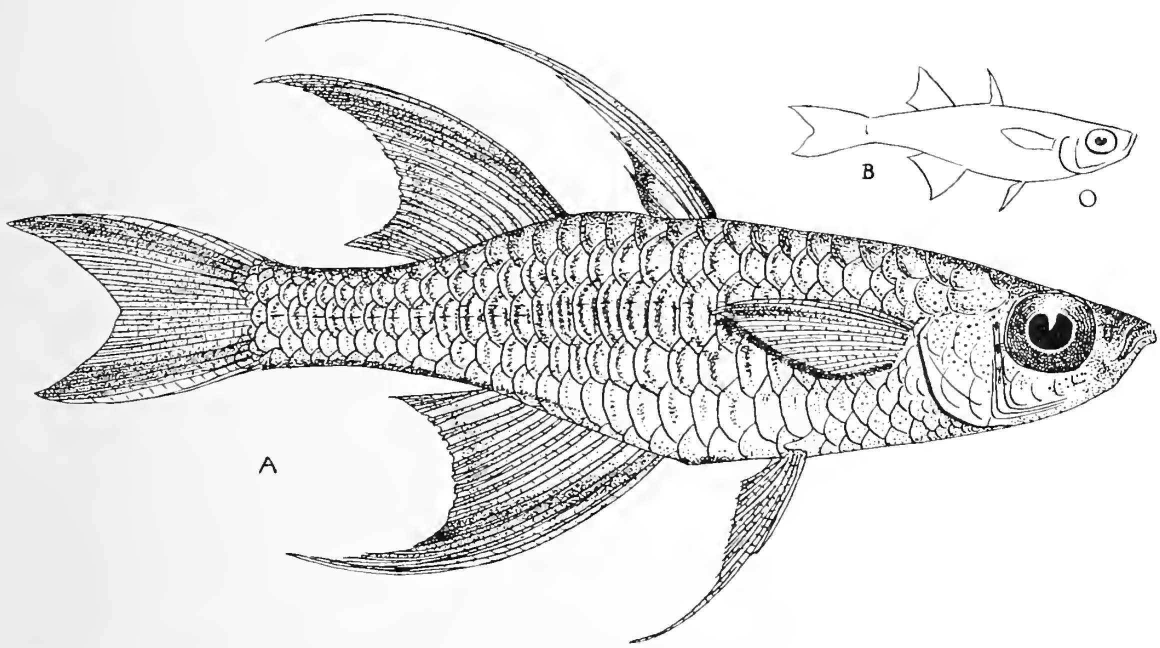
In shallow water near mangrove roots were thousands of these little fishes, which could be netted as they swam in schools.

Colours in Life.—Olivaceous above, each scale with a darker edge; becoming white on sides and belly. A brownish lateral band posteriorly and some blue spots on sides

anteriorly. A median dark line along back. Head bluish-silvery with a red flush on operculum. Eye blue, with black pupil. First dorsal olivaceous, the spines darker. Second dorsal largely orange-yellow, with some anterior rays and their membranes blackish.

Anal rays smoky, the fin with a white margin. Median portion of caudal yellow; some upper and lower rays blackish with the top and bottom of the tail white-edged. Upper pectoral rays blackish, remainder of fin white (29th August, 1928).

Pseudomugil signatus is represented in the Australian Museum collections by ten specimens (I.9971) from freshwater near Townsville, Queensland, two (I.13634) from Dunk



TEXT-FIG. 2.—*Pseudomugil signatus* (Günther). A. A male from Low Isles (much enlarged); regd. no. IA.4340. B. A female from Low Isles with one of its ova (enlarged); regd. no. IA.4341. Drawings by Gilbert P. Whitley.

Island, and the series of forty-eight specimens (IA.4339–4343) from Low Isles noted above, of which a male (IA.4340) and a female (IA.4341) are here figured.

This species is allied to *Pseudomugil novaeguinae*, Weber. It was wrongly united with *P. signifer*, Kner (Reise Novara, Zool. 1867, p. 275, pl. xiii, fig. 5), by Günther (Zool. Record, 1867 [1868] p. 166), but Kner's Sydney species is less ornate in coloration than the northern form.

Family MUGILIDAE.

Genus *Ellochelon*, Whitley, 1930.

Ellochelon vaigiensis (Quoy and Gaimard).

Two small specimens (IA.4465) from Low Isles, September, 1928. When swimming, the young appear to have a black-margined, saddle-shaped light area on the back,

reminiscent of the markings of *Terapon servus*, but after death this colour-effect fades and the back becomes more regularly dusky.

All the specimens seen were of small size and swam in little schools, or in pairs, in the moats; they kept close together and sometimes congregated over hollows to feed upon matter in the sand (*cf.* Duncker and Mohr, Mitt. Zool. Mus. Hamburg, xlii, 1926, p. 131, figs. 4, 5).

Genus *Mugil*, Linnaeus, 1758.

Mugil delicatus, Alleyne and Macleay.

Mugil delicatus, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. March, 1877, p. 341, pl. xv, fig. 1 (Cape York, Queensland). Types in Macleay Museum, University of Sydney.

D. iv/i, 8; A. ii/9; P. 17; V. i/5; C. 12.

Sc. 39 to hypural. L. tr. 15. Sc. $\frac{1}{2}/8/\frac{1}{2}$ on caudal peduncle.

Head, 3 in.; length to hypural, $11\frac{1}{4}$; length to end of middle caudal rays, $12\frac{1}{2}$; depth $3\frac{1}{8}$; pectoral, $2\frac{3}{4}$; depth of caudal peduncle, $1\frac{3}{8}$; interorbital, $1\frac{1}{2}$.

A narrow eyelid present. Narrow lanceolate interspace on chin. Maxillary entirely covered by preorbital.

Preorbital covered by skin, with spaced serrations. No teeth in jaws or on palate. Symphysis of lower jaw elevated. Thickness of upper lip equal to pupil of eye. Gill-rakers very numerous and close-set, but not nearly as long as gill-fringes. About 21 predorsal scales. Cycloid scales on head. Small scales extend along dorsal, anal and caudal rays.

Last dorsal and anal rays divided. Axillary scales well developed. Tip of pectoral reaching vertical of dorsal origin.

Second dorsal slightly in advance of anal, subequal in height to first dorsal. Caudal peduncle not as long as head.

Soft dorsal, anal and caudal margins excavate.

Colours in Life.—Dorsal scales olive grey, each one darker edged, with an inframarginal lighter area. Lateral scales greyish-silver, and ventral scales silvery white; anal scales shot with blue. Dorsal fins smoky grey, a narrow lighter margin to soft dorsal. Caudal grey, shot with an electric blue and greenish sheen near bases of rays. Anal greyish, the spinous and marginal portions white. Ventrals white. Pectoral light smoky grey, darkest mesially and on border of first ray, with white edge and base. A blue-black axillary blotch. Upper portion of upper lip stippled smoky; rest of mouth, jaws, and membranes white. Top of snout darker than rest of head. The darker dorsal shade changes to white on the opercles on a level with the upper part of the eye and the pectoral blotch. Pupil black, surrounded by a white ring; rest of eye smoky brownish.

Described from one (IA.4483) of several specimens seen swimming in a thick scum of algae inshore at Low Isles on 22nd August, 1928, and speared by one of the aboriginals. Owing to its rather large size only the head and some scales were preserved, but a sketch and the above description were made in the field after its capture.

Other specimens in the Australian Museum from Cape York, and Murray Island, Queensland.

The Low Isles specimen agrees with description of *Mugil splendens*, De Vis, but I

have no specimens for comparison, and a sketch of the type shows a fish with Sc. 41 and a thicker upper lip. Jouan (Mém. Soc. Nat. Sci. Cherbourg, XXI, 1877, p. 333) regards *M. delicatus*, Alleyne and Macleay, as a synonym of *Mugil tegobuan*, Montrouzier (*i. e.* Thiollière, Ann. Sci. Phys. Nat. Agric. Lyon, VIII, p. 462, 1856: Essai Faun. Île Woodlark [Montrouzier], 1857, p. 184), but the latter is described as having teeth. Fowler (Mem. Bishop Mus. X, 1928, p. 124) unites *M. tegobuan* with *M. vaigiensis*, Quoy and Gaimard, and quotes Jouan in the synonymy.

Family Epinephelidae.

Genus *Epinephelus*, Bloch, 1793.

Epinephelus hoevenii (Bleeker).

(Plate II.)

? *Holocentrus caeruleopunctatus*, Bloch, Naturgesch. Ausl. Fische IV, 1790, p. 94, pl. ccxlii, fig. 2. Locality unknown.

Serranus hoevenii, Bleeker, Verh. Batavia Genoot. XXII, 1849, Perc., pp. 19 and 36. Batavia.

Serranus kunhardtii, Bleeker, Natuurk. Tijdschr. Ned. Ind. II, 1851, p. 169. Padang, Sumatra.

Epinephelus hoevenii, Bleeker, Atlas Ichth. VII, 1875, p. 63, pl. cclxxxii, fig. 1, pl. cclxxxvi, fig. 4, and pl. ccxc, fig. 4 (plates published 1870). East Indies.

Epinephelus caeruleopunctatus, Boulenger, Cat. Fish. Brit. Mus. Ed. 2, I, 1895, pp. 171 and 246; McCulloch, Proc. Linn. Soc. N.S.W. XLVI, 1921, p. 468. Queensland, etc.

A specimen from Low Isles (IA.4426) figured here, has D. xi/16; A. iii/8; V. i/5; P. 17; C. 15. It was caught with a smaller one (IA.4427) under stones in September, 1928.

Another specimen (IA.4502), larger than the one figured but also from Low Isles, has the following characteristics: D. xi/16; A. iii/8.

Eye equal to snout, almost 5 in head, which is nearly 3 in total length. Depth of body less than length of head.

Maxillary with some rudimentary scales.

A single anterior canine on each side of the symphysis of each jaw. Teeth in broad bands on jaws, becoming caniniform behind symphyses and on sides of mandibles posteriorly. A few teeth on vomer and palatines.

Interorbital less than diameter of eye, over 8 in head.

Upper limb of preoperculum serrated. Middle opercular spine much nearer lower than upper.

Scales mostly ciliated, in less than eighty transverse series on body, the rows slanting upwards and backwards. About twenty scales between origin of dorsal and lateral line.

Third to last dorsal spines subequal but not as long as anterior dorsal rays. Margin of all soft fins rounded.

General colour (in spirit) brown, covered with whitish spots of various sizes, but all less than eye and becoming faint on head. A dark brown " moustache " and a small dark blotch over caudal peduncle. Pectorals, ventrals, and anal duskier than dorsals and caudal.

Epinephelus corallicola (Cuvier and Valenciennes).*

Serranus corallicola, Cuvier and Valenciennes, Hist. Nat. Poiss. II, October, 1828, p. 336. *Ex.* Kuhl and van Hasselt MS. No locality (= Java); Macleay, Proc. Linn. Soc. N.S.W. II, 1878, p. 346 (Port Darwin); Fowler, Mem. Bishop Mus. X, 1928, p. 181.

Epinephelus corallicola, Boulenger, Cat. Fish. Brit. Mus. Ed. 2, I, 1895, p. 236; McCulloch, Mem. Aust. Mus. V, 1929, p. 147.

Serranus rubriniger and *S. subniger*, Saville-Kent, Gt. Barrier Reef, 1893, p. 369. *Nomina nuda.* Queensland.

A specimen (IA.4456) from Low Isles has the following characters: D. xi/16; A. iii/8(9).

Interorbital width less than diameter of eye.

Preoperculum serrated, but without strong spines at angle.

Middle opercular spine nearer lower than upper. Opercular flap excavate above. Broad bands of teeth in jaws, caniniform anteriorly. Maxillary naked.

Eye between 4 and 5 in head.

Scales ciliated. 53–57 tubes in l. lat. to hypural. Sc. *c.* 65 to 70 from head to hypural. L. tr. 16/1/40–45.

Fourth dorsal spine longest, the posterior spines gradually decreasing in length. Caudal rounded.

Dark brown, with large, widely spaced, black spots on head, body, and the dusky fins. Caudal with narrow white margin.

Total length 152 mm. Registered number IA.4456.

New record for Queensland. Specimens from New Guinea and Port Darwin, identified by Sir William Macleay, compared in the Australian Museum. Two *nomina nuda* of Saville-Kent, *Serranus rubriniger* and *S. subniger*, may best be disposed of by being relegated to the synonymy of this species.

Epinephelus merra, Bloch.

Four specimens (IA.4457, 4486–8) of this common coral fish from Low Isles. Large specimens were seen hiding in empty clam-shells (*Hippopus*) near the mangroves; they looked rather like the mantles of the clams, which barely filled the shells.

Genus *Plectropomus*, Schinz, 1822.

Plectropomus maculatus (Bloch).

A fine specimen (IA.4479) caught by Mr. Carl Vidgen off Low Isles.

* *Serranus australis*, Castelnau (Res. Fish. Aust. 1875, p. 7; C. York) is described with D. xi/13 and different coloration. The Low Island specimen has fewer spots and narrower pre-orbital than *Serranus howlandi*, Günther (J. Mus. Godeffroy, III [Fische Südsee], 1873, p. 8, pl. ix, fig. B; Howland Is.).

Family Apogonidae.

Genus *Lovamia*, Whitley, 1930.

Lovamia cookii (Macleay).

Apogon fasciatus, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, 1877, p. 267 (Queensland). Not *Mullus fasciatus*, White, 1790.

Apogon cookii, Macleay, Proc. Linn. Soc. N.S.W. V, February, 1881, p. 344 (Endeavour R. (type) an Darnley I., Queensland). Types in Macleay Museum, University of Sydney; *op. cit.* VII, 1882, p. 236 (Port Moresby, New Guinea); Fowler, Mem. Bishop Mus. X, 1928, p. 157.

Amia fasciata fasciata McCulloch, Biol. Res. "Endeavour," III. 3, 1915, p. 116 (North Queensland specimens).

Apogon endekataenia, Ogilby, Proc. Roy. Soc. Qd. XXI, 1908, p. 23 (Green I. and Dunk I., Queensland). Not *A. endekataenia* Bleeker, Natuurk. Tijdschr. Ned. Ind. III, 1852, p. 349, which has narrower stripes.

A Batt Reef specimen (IA.4065) agrees with other Great Barrier Reef examples in the Australian Museum in having D. vii/i. 9 : A. ii/9. Twenty-eight tube-bearing scales on l. lat. Pectoral base without dark mark. Bands of body not continued on to tail, but converging slightly above and below large black spot at root of caudal. McCulloch regarded the North Queensland species as conspecific with *Mullus fasciatus*, White, but Sydney specimens have a deeper body, smaller eye, median band continued on caudal fin and no blackish blotch at base of tail. *Amia robusta*, Radcliffe (Proc. U.S. Nat. Mus. XLI, 1911, p. 254, pl. xxiv, fig. 2), is apparently a Philippine subspecies of *Lovamia cookii*. The Batt Reef specimen agrees with Hombron and Jacquinot's figure of *Apogon aroubiensis* (Voy. Pôle Sud., Zool. III, Poiss. 1853, p. 31, pl. i, fig. 1) in having a short snout and large eye, also in general form, but their illustration shows neither the anterior intercalated dorso-lateral bands, nor the spot at the root of the caudal which is so characteristic of *Lovamia cookii*.

It may be of interest to record here that the type-locality of *Apogon aroubiensis*, originally called Aroub, Malaysia, is Darnley Island, Torres Strait, which is still called Aroub or Erub by North Queensland aboriginals.

Lovamia cookii was common at Low Isles and Batt Reef and many young specimens (IA.4070, 4432, 4448 and 4504) were collected. These were found poised in swarms in still water sheltered by large blocks of coral such as *Porites*, or swimming between the long spines of sea-urchins (*Centrechinus setosus*), and could be caught in numbers with one sweep of a net. A series of nineteen specimens, 11–19 mm. long, caught in this way at Low Isles shows that the three main longitudinal bands, blotch at root of caudal and plain fins are juvenile as well as adult characters. The largest specimens have scales and incipient serrations on the preoperculum.

Weber and Beaufort (Fish. Indo-Austr. Archip. V, 1929, p. 306) regard *Apogon cookii* as a synonym of *A. endekataenia*, Bleeker, but although Bleeker's original description of the type from Banka agrees fairly well with the Queensland species, his figure (Atlas Ichth. VII, 1872, p. 85, plate cccx, fig. 2) shows a fish with much narrower bands on the body.

Genus *Foa*, Jordan and Evermann, 1905.

Foa vaiulae, Jordan and Seale.

Three specimens (IA.4461) from Batt Reef, caught in trailing brown weed, 13th September, 1928, and one (I.14507) from Walker's Bay, near Cooktown, are in the Australian Museum. The latter specimen is 45 mm. in length and was collected by A. R. McCulloch. Another small one (IA.4473) from Low Isles is darkly mottled, with traces of a transverse band on body and an opercular spot.

This species has not hitherto been recorded from Australia.

The East Indian *Foa fistulosa*, Weber (Notes Leyden, Mus. XXXI, 1909, p 162, and Fische Siboga Exped. 1913, p. 237, and fig.) should receive a new generic name, as that species has a subcutaneous tube on the tail which is lacking in species of *Foa*.

Genus *Aspiscis*, Whitley, 1930.

Aspiscis savayensis (Günther).

One (IA.4503) from Low Isles; amongst coral, reef flat, 1st October, 1928.

Family Sillaginidae.

Genus *Sillago*, Cuvier, 1816.

Sillago gracilis, Alleyne and Macleay.

Sillago gracilis, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, Feb. 1877, p. 279, pl. vi, fig. 2. Hall Sound, New Guinea or Darnley Island, Torres Strait, Queensland.

D. xi/i, 17; A. i/16. L. lat. 65 to hypural.

L. tr. 6/1/13.

Head (70 mm.) 3·3, depth (45) 5·1 in standard length (230). Interorbital (16) 4·3, eye (13) 5·3 in head.

Depth of caudal peduncle (21) less than postorbital portion of head (26). Preorbital (26) 2·7, pectoral (38) 1·9 in head.

Villiform teeth on jaws and roof of mouth.

Opercles entire.

Dorsals separate. First ventral rays with filiform tips.

The above are the characters of a specimen (IA.4481) caught on a small hook with mullet and pipi bait at Low Isles over sandy bottom inshore on 23rd August, 1928. A young one (IA.4466), with spotted body, was also obtained. The life colours of the larger specimen were as follows:

Light olive dorsally, darkest before the eyes. each scale with a darker margin. Ventral surface and most of sides white. First dorsal hyaline with large irregular smoky blotches. Second dorsal faint yellow with rows of smoky marks. Caudal light yellow, edged with smoky. Ventrals and anal white with a tinge of yellow. Pectorals hyaline with a blackish

blotch on base. Pupil black, rest of eye pearly with dark grey superiorly. A small grey mark near the root of each ventral.

Family Lutjanidae.

Genus *Lutjanus*, Bloch, 1790.

Lutjanus fulvifiamma unimaculatus, Quoy and Gaimard.

One (IA.4478) from Low Isles agrees perfectly with Quoy and Gaimard's description. Very common over open waters with sandy bottom in vicinity of mangroves.

Family Leiognathidae.

Genus *Equula*, Cuvier, 1816.

Equula, Cuvier, Mem. Mus. Hist. Nat. Paris, I. " 1815 " = March, 1816, pp. 463 and 466. Genotype, *Scomber equula*, Forskal [= *Equula equula* (Bonnaterre)].

Head about one-third of standard length. Preoperculum serrated. Mouth protractile obliquely downwards. Second dorsal spine not produced. Eight dorsal spines. Depth about half the length of the fish. A band of curved, bristle-like teeth in each jaw. Breast and thorax naked. Lateral line ceasing just before root of caudal. Supra-orbital finely denticulated. No conspicuous colour markings.

These characteristics define the genus *Equula*, Cuvier, as distinct from *Leiognathus*, Lacepède. I have in manuscript a revision of the family Leiognathidae based on the collections in the Queensland and Australian Museums, and intend to give details in that paper of the limits of the genera and subgenera, concerning which some complex points in taxonomy have arisen. Mr. H. A. Longman has kindly lent me the types of the species described by De Vis and by Ogilby, which I intend to redescribe and illustrate in due course.

Equula obscura (Seale).

(Plate III, fig. 1.)

Leiognathus obscura, Seale, Occ. Pap. Bishop Mus. I, 3, 1901, p. 74. Guam, Marianas.

A large specimen (IA.4498), netted offshore at Low Isles, 24th September, 1928, has the following characters:

D. viii/16; A. iii/14. Curved bristle-like teeth in jaws. Lower preopercular margin distinctly serrated, as long as mandible. Supraorbital weakly denticulated. Caudal fin strongly forked. Depth (95 mm.) 1·6 in standard length (155) or a little over 2 in total length ($7\frac{9}{16}$ in.). Longest dorsal spine (33) 1·3, and longest anal spine (26) 1·7 in head (46).

This is probably the species regarded as *Leiognathus equula* by Australian writers. The figure of *Equula edentula* in Day's Fishes of India is very like the Low Isles specimen,

which only seems to differ in colour and minor features. However, *Equula edentula*, Day, is not the same as *Scomber edentula*, Bloch, but is apparently *Equula coma*, Cuvier; this point will be more fully discussed in my forthcoming paper on the family Leiognathidae. Fowler (Mem. Bishop Mus. X, 1928, p. 153) unites *Leiognathus obscura*, Seale, with the Red Sea species described by Forskål which I regard as *Equula equula* (Bonnaterre), but the Pacific form appears to be at least subspecifically distinct.

Family Gerridae.

Genus *Gerres*, Quoy and Gaimard. 1824.

Gerres splendens, De Vis.

Gerres splendens, De Vis, Proc. Linn. Soc. N.S.W. IX, 19th August, 1884, p. 400. Cardwell, Queensland. Holotype in Queensland Museum; Whitley, Mem. Qd. Mus. X, 1930, p. 15, fig. 1 (holotype redescribed and figured).

A series of sixteen specimens from Low Isles mangrove swamps (IA.4331–4334) and two collected by Dr. Paradice from the same locality (IA.1697) have been compared with the type in the Queensland Museum. Young ones have the depth a little more than 3 in length to end of middle caudal rays, but in adults it is 3 or even a trifle less. Dorsal generally ix/10; only one has D. ix/11 and another D. ix/9. Second dorsal spine a little over 2 in depth of body. Suborbital and opercles smooth. L. lat. usually 41; rarely 40, sometimes 42 and occasionally 43–44.

Eye longer than snout and than anal spines. Pectoral not quite reaching anal origin. Upper caudal lobe subequal to head. Tip of first dorsal black; some dark spots on dorsal rays. Young bright silvery in general colour; adults with no spots on body, but sometimes with indistinct bars of darker scales.

This is perhaps one of the species regarded by Australian authors as *Labrus oyena*, Forskål.

Three post-larvae of this species (IA.4471, 4476) were tow-netted at night on 8th September, 1928. One very small specimen had a parasite like *Gnathia* near the tail. The majority of the larger specimens was obtained by making the water muddy by stirring up the bottom with the feet when wading; the fish were thus stupified and could be easily netted.

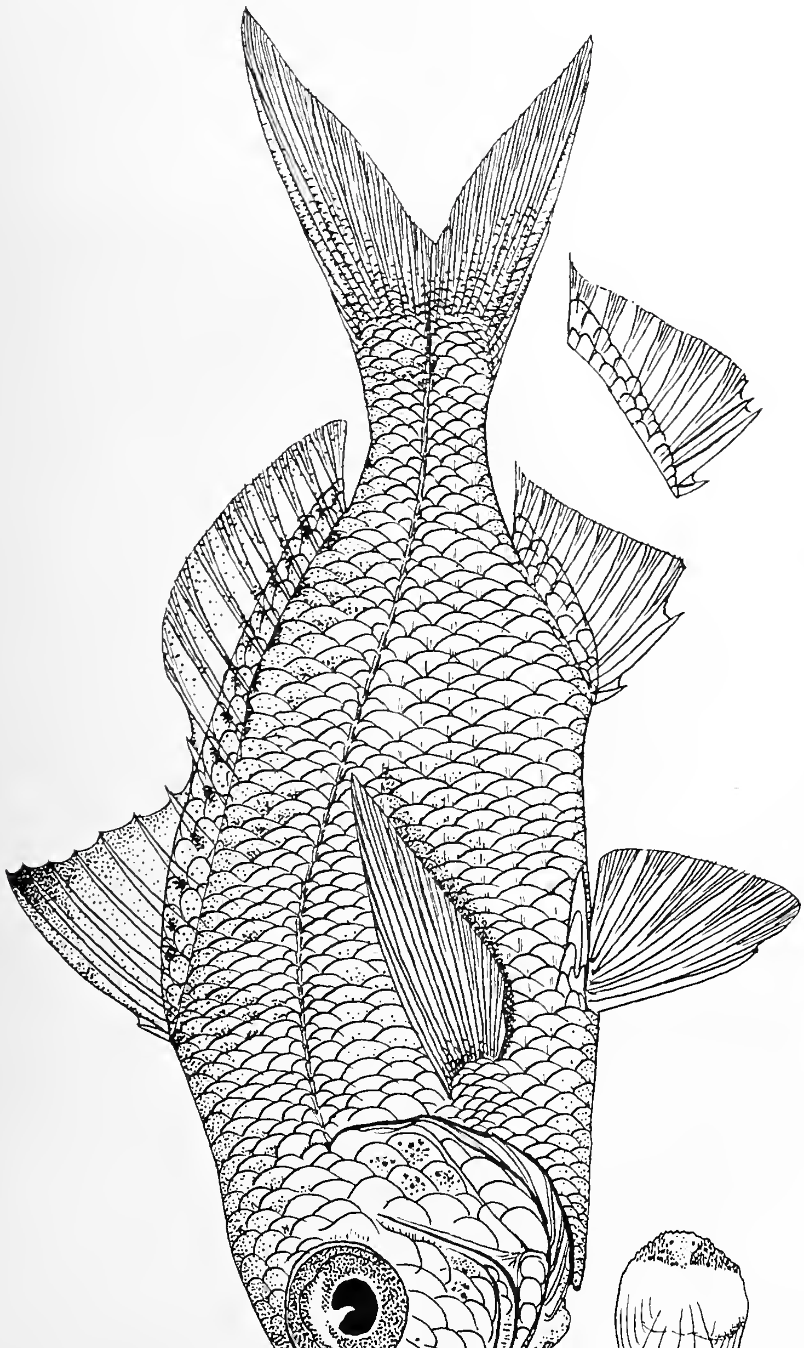
One specimen (IA.4614) was caught by seine net at North-West Islet, Capricorn Group, in May, 1930, by Mr. Melbourne Ward, so that this species evidently extends its range all along the Queensland coast.

Family Chaetodontidae.

Genus *Chaetodon*, Linnaeus, 1758.

Chaetodon lunula (Lacepède).

A juvenile specimen in the "*Tholichthys*" stage (IA.4078) was caught beneath a boulder on the reef at Low Isles. It agrees with Günther's figure (Fische der Sudsee,



TEXT-FIG. 3.—*Gerres splendens*, De Vis. A specimen from Low Isles. Regd. no. IA.4333. Also a lateral scale of the same specimen and the normal form of anal fin drawn from a larger specimen from the same locality. Drawings by Gilbert P. Whitley.

pl. xxxiii, fig. D), but, as is sometimes the case in young specimens of this species, it lacks the dorsal ocellus.

COLOURS IN THE FRESH STATE.—General body colour pale yellow. Face whitish. The broad black ocular bands form a V-shaped mark on the breast before the ventrals; above the eye each band becomes browner with a lighter median area, and there is a blackish superciliary mark. Some black punctulations on the operculum and shoulder and above anal fin. An irregularly saddle-shaped blackish area below the hinder part of the dorsal and a narrow band around the caudal peduncle. First dorsal, ventrals and anterior portion of anal yellow. Pectorals, soft dorsal, caudal and posterior portion of anal hyaline.

Chaetodon vagabundus, Linnaeus.

One specimen from Low Isles, collected by Mr. F. W. Moorhouse, in the Queensland Museum (I.4589).

Genus *Rabdophorus*, Swainson, 1839.

Rabdophorus bennetti (Cuvier and Valenciennes).

Chaetodon bennetti, Cuvier and Valenciennes, Hist. Nat. Poiss. VII, 1831, p. 84; Sumatra; Fowler and Bean, Bull. U.S. Nat. Mus. 100, VIII, 1929, p. 73 (references and synonymy).

One young specimen (IA.4455) of this well-marked species from Low Isles. New record for Australia.

Genus *Megaprotodon*, Guichenot, 1848.

Megaprotodon plebeius (Cuvier and Valenciennes).

Chaetodon plebeius, Gmelin, Syst. Nat. (Linnaeus), ed. 13, I, 3, 1789, p. 1269, footnote; *ex* Broussonet MS.; *nom. nud.*
Chaetodon plebeius, Cuvier and Valenciennes, Hist. Nat. Poiss. VII, April, 1831, p. 68; *ex* Broussonet MS. Mer du Sud; Fowler and Bean, Bull. U.S. Nat. Mus., 100, VIII, 1929, p. 78.

A juvenile specimen (IA.4069) 15 mm. in total length from Batt Reef.

Genus HOLACANTHUS, Lacepède, 1802.

Holacanthus sexstriatus, Cuvier and Valenciennes.

A large specimen from Low Isles in the Queensland Museum (I.4586). Another recorded from the same place by Tandy (Nat. Hist. Mag., London, July, 1929, II, p. 87, fig. 5).

Subgenus *Acanthochaetodon*, Bleeker, 1876.

Holacanthus (*Acanthochaetodon*) *semicirculatus*, Cuvier and Valenciennes.

One in the Queensland Museum (I.4639) from Low Isles.

Family Scomberomoridae.

Genus *Scomberomorus*, Lacepède, 1802.

Scomberomorus commerson (Lacepède).

Some fisherman caught twenty-six Kingfish of this species near Snapper Island on 5th September, 1928. No specimens were preserved, but the following notes were made at the time.

"These fish were about nine or ten pounds in weight when cleaned and were developing the reproductive organs. The fishermen say they begin to get them here about June or July when they come up from the south. In about another month they will be larger and mature and will spawn about November. They are caught here until December, when they go south again.

"A lily or a piece of white or red rag is used as bait and trolled behind a launch. Kingfish bite very ferociously and are often caught in numbers. They do not stay long in one place, however, and may not be encountered the day after a good catch has been made."

Family Amphacanthidae.

Genus *Amphacanthus*, Bloch and Schneider, 1801.

Amphacanthus lineatus, Cuvier and Valenciennes.

Amphacanthus lineatus, Whitley, Rec. Aust. Mus. XVI, 1928, p. 231 (synonymy and localities).

A specimen from Low Isles (IA.4054).

Family Amphiprionidae.

Genus *Amphiprion*, Bloch and Schneider, 1801.

Amphiprion bicinctus, Rüppell.

I am informed that Dr. T. A. Stephenson collected this species at Low Isles from a sea-anemone (*Stoichactis*).

Genus *Actinicola*, Fowler, 1904.

Actinicola percula (Lacepède).

(Plate I, fig. 2.)

Three Batt Reef specimens (IA.4062–4064) have D. x/16; A. ii/13; light snout, breast and pectorals; areas between dark-edged bands, pectorals, and most of caudal light in tone. They were collected by Messrs. McNeill and Livingstone, who noted them as commensals of an anemone.

Two specimens (I.4640–4641) in the Queensland Museum from Low Isles.

HABITS.—*Actinicola percula* was fairly common at Low Isles associated with the large sea-anemones (*Stoichactis*). Registered numbers of specimens preserved IA.4062–4, 4092. I made the following field observations on them :

The fish swims by turning body and tail to left, at the same time bringing left pectoral to side, then repeats action on right side. The ventral fins are kept extended all the time the fish is swimming as if feeling for bottom and are rarely moved ; this is a noteworthy feature in *Actinicola* and *Amphiprion.* The dorsal and anal are kept extended and lean from one side to another. A specimen kept in a bottle overnight was still active next morning, a feat of hardiness rare in a coral-reef fish, but probably this species has to withstand great changes of salinity, temperature, etc. I placed it amongst the tentacles of a different anemone on another part of the reef. After swimming about for some time as if to get its bearings, the fish snuggled into the tentacles, gently waving its fins, or else sheltered in the folds of the anemone, but I could not induce it to enter the anemone's mouth. The fish adopted its new host and was always to be found with it during my stay at Low Isles, and I added further specimens from time to time. *Actinicola percula* is sometimes accompanied by one or more prawns (*Periclimenes*) in association with an anemone, although the view is popularly held that the two organisms are not found together with their host. A photograph by Mr. W. Boardman of the fish and an anemone *in situ* is reproduced here.

An early figure of this species was given by Valentyn (Amboina, III, 1726, fig. 525) and a Great Barrier Reef specimen was artistically described by Hedley (The Nautilus, XV, 1902, 9, p. 99.)

JUVENILE SPECIMENS.—At Batt Reef on 13th September, 1928, I collected in a small sea-anemone which differed from the large Low Isles species two small specimens of *Actinicola percula* (IA.4063–64). These were more active swimmers than the adult forms and there were no prawns with them. D. x/16 ; A. ii/13–14. Yellow on snout, breast, margin of pectorals and lower half of caudal peduncle ; areas between the two white bands crossing the body dark brown ; upper rays of caudal white, lower part of caudal mostly black ; pectorals mostly blackish. The blackish band passing through the eye does not join its fellow on the other side below the head. This is the juvenile colour-phase of the species, and has been figured in colours by Saville-Kent (*loc. cit.*) as *Amphiprion clarkii.* That species, however, was originally described as *Anthias clarkii* by Bennett (Fish Ceylon, April, 1830, p. 29, pl. xxix) and is a true *Amphiprion* with emarginate tail, deep body and scaly nape, and has not been found in Australian waters.

Family POMACENTRIDAE.

Subfamily *Pomacentrinae.*

Genus *Pseudopomacentrus,* Bleeker, 1877.

Pseudopomacentrus sufflavus (Whitley).

Mr. F. S. Russell obtained one specimen (IA.4429) at Low Isles. This species, which has the outer row of teeth conic terminally, not forming a compact cutting edge, is allied

to *P. amboinensis* (Bleeker), but has origin of dorsal further back and depth 2 in standard length. In the shape of the tail and less deep body, *P. sufflavus* differs from *P. niomatus* (De Vis), but the three species are evidently quite closely related. Nevertheless, they are still too close to the typical *Pseudopomacentrus* (*littoralis*) to be considered even subgenerically distinct at present.

Pseudopomacentrus wardi macleayi (Whitley).

Pomacentrus obscurus, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, March, 1877, p. 343, pl. xv, fig. 2. No locality (= Torres Strait, probably Darnley Island). Types in Macleay Museum, University of Sydney; lectotype described below. Name preoccupied by *Pomacentrus obscurus*, Thiollière, Ann. Agric. Soc. Lyon, VIII, 1856, p. 400; Essai Faune Île Woodlark (Montrouzier), 1857, p. 200; McCulloch and Whitley, Mem. Qd. Mus. VIII, 1925, p. 166.

Pomacentrus wardi, Whitley, Rec. Aust. Mus. XV, 6th April, 1927, p. 301, fig. 1; Heron I., Queensland. Holotype in Australian Museum: Whitley, Rec. Aust. Mus. XVI, 1927, p. 17 (Michaelmas Cay—variation).

Pomacentrus macleayi, Whitley, Rec. Aust. Mus., XVI, 28th March, 1928, p. 221; Torres Strait. New name for *P. obscurus*, Alleyne and Macleay, preoccupied.

Pseudopomacentrus macleayi, Whitley, Mem. Qd. Mus. IX, 1929, p. 236.

Pseudopomacentrus wardi, Whitley, Mem. Qd. Mus. IX, 1929, p. 237.

D. xiii/14; A. ii/13; P. i/17; V. i/5; C. 13.

17 tubes on l. lat. Sc. 24; L. tr. 2/1/9.

Head (17 mm.) 3·6 in length to hypural joint (62); depth (24) 2·5 in same. Snout (4) 1·2 in interorbital width (5), which is a trifle less than eye (5·5). Depth of caudal peduncle (8) 8·5 in total length (69).

Head scaly except on preorbital, jaws and throat. Rows of pores along the preorbital, whose margin is serrated and notched. Preoperculum strongly serrated. Two small opercular spines. Eye large. Interorbital convex. Mouth small, maxillary not reaching vertical of anterior margin of eye. A single series of compressed incisors in each jaw.

Form ovate, compressed. Body covered with ctenoid scales which extend on to all the fins except ventrals. About nineteen predorsal scales. Lateral line gently curved. Caudal peduncle not tapering abruptly.

Dorsal originating in advance of pectorals, its spines increasing in height backwards and interspaced with pencilled membranes; the soft dorsal terminates behind the anal. Caudal forked, the upper lobe longer.

Colour (after long preservation in alcohol) uniform straw-brownish with the ventrals and anal darker. A small black spot, margined anteriorly with white, on the caudal peduncle behind the last dorsal ray.

Described from the lectotype of *Pomacentrus obscurus*, Alleyne and Macleay, or the holotype of *P. macleayi*, Whitley. The specimen is $2\frac{3}{4}$ in. long and was figured by Alleyne and Macleay. It is one of four Torres Strait specimens which have been kindly lent me by the Curator of the Macleay Museum, University of Sydney, to whom I wish to record my thanks.

P. obscurus = *macleayi* is closely allied to *P. wardi*, and, after having compared many specimens of both forms, I have arrived at the conclusion that two subspecies are represented which may be distinguished as follows:

A. Depth 2 or less in length from snout to hypural joint. Usually 15 dorsal rays. Coloration brownish, no spot on caudal peduncle *P. wardi wardi.*

A.A. Depth more than 2 in length to hypural. 13 to 14 dorsal rays. Coloration olivaceous; most specimens with a black spot, margined with white anteriorly, on caudal peduncle behind last dorsal ray *P. wardi macleayi.*

Thus, *Pseudopomacentrus wardi macleayi* is evidently a northern subspecies ranging from Torres Strait down to the Whitsunday Passage, whilst *P. wardi wardi* extends from the latter place to the southernmost islets of the Great Barrier Reef.

These forms are so close to *Pomacentrus trilineatus*, Bleeker (Atlas Ichth., IX, 1877, pl. ccccvi, figs. 1–6; *non* Cuvier and Valenciennes, *s. str.*), and *P. niomatus*, De Vis (Proc. Linn. Soc. N.S.W. VIII, 1884, p. 451; Whitley, Mem. Qd. Mus. IX, 1929, p. 220, fig. 2), that they would be regarded as conspecific by the casual worker, but, after examining large series of Australian specimens, I am convinced that no good purpose can be served by uniting them, as many more races, varieties and subspecies of these fishes appear to exist within geographical limits than are at present recognized.

Pseudopomacentrus wardi macleayi was common at Low Isles, where the aboriginals called it "young bluefish." It sheltered beneath boulders at low water and could be easily netted. The general coloration was olive greenish, often irregularly blotchy. Others are described in my notes as "dark olive greenish, each scale grey-edged." A small specimen had a tiny violet spot at the termination of the dorsal fin. There is a tendency towards a light inframarginal band along the spinous dorsal, whilst the anal and ventrals are darker.

Thirty-one specimens (IA.4080–4086) from Low Isles in the Australian Museum and three (I.4498–4500) in the Queensland Museum.

A specimen collected at Low Isles by Dr. Paradice (IA.1699) and another from Port Darwin (IA.3603) have a black ocellus on the median dorsal rays and three rows of scales on the cheeks. These specimens are 36 mm. in standard length.

Subfamily *Glyphisodontinae*.

Genus *Glyphisodon*, Lacepède, 1802.

Glyphisodon palmeri, Cockerell.

Two specimens from Low Isles (IA.4330 and 4484).

Range.—North Australia and Queensland.

Glyphisodon coelestinus, Cuvier and Valenciennes.

One specimen (IA.4097) from Low Isles, August, 1928.

Genus *Glyphidodontops*, Bleeker, 1877.

Glyphidodontops biocellatus (Quoy and Gaimard).

Glyphisodon biocellatus, Quoy and Gaimard, Voy. Uranie and Physicienne, Zool., 1825, p. 389; Guam.

Glyphisodon antjerius, Cuvier and Valenciennes, Hist. Nat. Poiss. V, July, 1830, p. 481; *ex* Kuhl and van Hasselt MS.; Java.

Abudefduf biocellatus, Fowler and Bean, Bull. U.S. Nat. Mus. 100, VII, 1928, pp. 124 and 166 (references and synonymy).

One small specimen (IA. 4433) is referred to this species : it agrees with the form called *Glyphisodon antjerius*. New record for Australia, since the species identified as *G. antjerius* from New South Wales is the young of *Parma*. I regard *Chaetodon brownriggii*, Bennett, (Fish. Ceylon. June. 1828. p. 8. pl. viii : Ceylon). as distinct.

The following notes were made on 21st September. 1928, after the specimen had been kept alive in a finger-bowl overnight :

Life Colours.—Dark olivaceous on top of head and back ; brilliant yellow on lower parts of head, sides, and caudal peduncle. Two brilliant blue bands on each side of snout ascending obliquely backwards ; the lower one passes through the dark bluish eye. A large black ocellus on second dorsal, surrounded by brilliant blue. Anterior dorsal rays bluish, posterior rays orange-yellow. Ventrals and anal orange, some of the rays black-tipped. Pectorals and caudal hyaline.

This species was sometimes seen swimming slowly near banks of coral in the inner rampart and madrepore moat, but was difficult to catch as it could hide amongst the most inaccessible coral branches or take short cuts through the smallest gaps. Others fed on minute material on the coral debris banks flanking the edge of the mangrove swamp associated with other Pomacentridae.

Family Chromidae.

Genus *Chromis*, Cuvier. 1814.

Chromis nitidus (Whitley).

Tetradrachmum nitidum, Whitley, Rec. Aust. Mus. XVI, 1928, p. 219, pl. xvii, fig. 3 ; Hayman Island, Queensland.

One young one (IA. 4449) from Batt Reef, 13th September, 1928. Several young were swimming round blocks of *Porites* and, as this was the first time I had seen this species alive, I noted that the top of the head was brilliant yellow margined by a black band. Sides silvery and, by contrast, almost invisible in the water. Closer inspection revealed the dark streaks on the anal and caudal fins. This species was also common on an uncharted reef between Batt and Tongue Reefs, visited 27th September.

Genus *Tetradrachmum*, Cantor, 1849.

Tetradrachmum aruanum (Linnaeus).

Two (IA.4095–4096) from Low Isles.

Genus *Hoplochromis*, Fowler, 1918.

Hoplochromis caeruleus (Cuvier and Valenciennes).

Two (IA.4061) from Batt Reef.

Family Labridae.

Genus *Hemigymnus*, Günther, 1861.

Subgenus *Cheilolabrus*, Alleyne and Macleay, 1877.

Hemigymnus (*Cheilolabrus*) *melapterus* (Bloch).

One young specimen (IA.4428) agreeing with Bleeker's figure (Atlas Ichth., I, 1862, p. 412, pl. xlv, fig. 3) from coral block in the madrepore moat, Low Isles.

Cheilolabrus, Alleyne and Macleay, 1877, may be used subgenerically for the species lacking several whitish transverse bands. This name was amended to *Chi*(*lolabrus*) on p. 2 of the Index to the Zoological Record for 1877 (published 1879). *Thalliurus*, Swainson, 1839, was proposed for *C*(*heilinus*) *blochii*, Swainson [not Cuvier and Valenciennes, 1839 (= *Hemigymnus fasciatus*)], based on *Labrus chlorourus*, Bloch, 1791, which is not congeneric with *Hemigymnus*.

Family Julidae.

Genus *Octocynodon*, Fowler, 1904.

Octocynodon margaritaceus (Cuvier and Valenciennes).

One (IA.4453) from Low Isles. This species has been called *Halichoeres opercularis* by Australian authors.

Octocynodon miniatus (Cuvier and Valenciennes).

Three (IA.4454) from Low Isles.

Genus *Guntheria*, Bleeker, 1861.

Guntheria trimaculata (Griffith).

One (IA.4505) from Batt Reef; 13th September, 1928. D. ix/11; A. iii/11.

Family Coridae.

Genus *Hemicoris*, Bleeker, 1861.

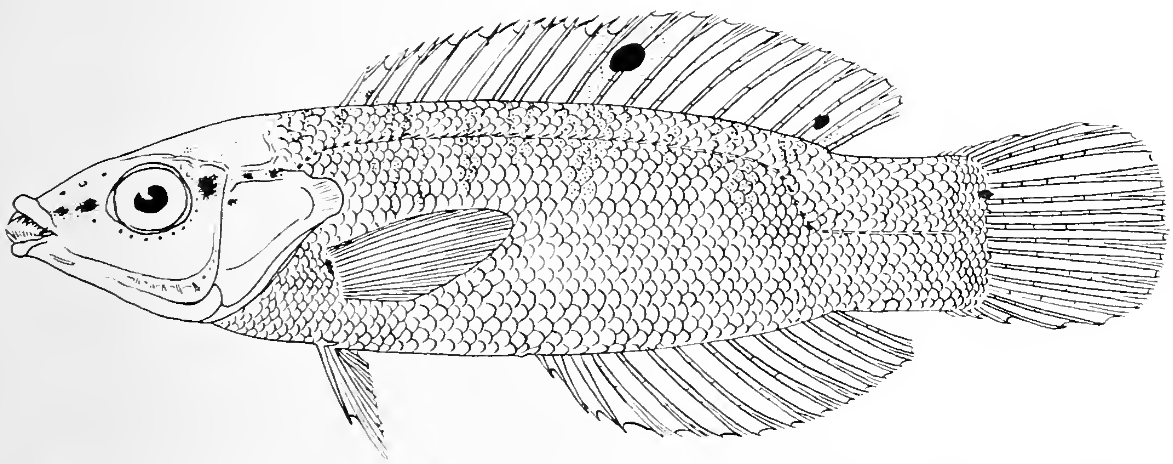
Hemicoris pallida (Macleay).

Coris pallida, Macleay, Proc. Linn. Soc. N.S.W. VI, July, 1881, p. 100; Endeavour River, Queensland. Holotype in Macleay Museum, University of Sydney.

Two small specimens (IA.4460) from a trailing brown seaweed on sandy bottom at Batt Reef, 13th September, 1928. A larger specimen is in the Australian Museum from Murray Island, Queensland.

CHARACTERS.—Cheeks naked. Preoperculum entire. Depth less than length of head and less than 5 in total length. Lateral line continuous, bent abruptly behind, with fifty-six scales, of which forty are on the straight anterior portion. L. tr. 6/20. D. ix/11; A. iii/11. No produced dorsal spines. Caudal rounded. Pectoral subequal to distance from posterior margin of eye to snout.

General colour, in spirits, yellowish brown, silvery on thorax and with five or six faint dusky transverse bars, with traces of white intermediate bars, on body. Eye surrounded by milky-blue, forming a post-orbital mark. No marks on cheek, but one specimen has a dusky pre-orbital blotch. A black spot between the first and second dorsal spines, a larger white-edged one on second dorsal ray, and a small spot between ninth and tenth dorsal rays. A black dot on upper half of caudal root. A dark brown bar on pectoral base.



TEXT-FIG. 4.—*Hemicoris pallida* (Macleay). A specimen from Batt Reef. Regd. no. IA.4460. Drawing by Gilbert P. Whitley.

This species is near *Halichoeres variegatus*, Rüppell (Neue Wirbelth. Abyssin. Fische, 1835, p. 14, pl. iv, fig. 2), from the Red Sea, but differs in coloration, and in having a narrower cheek and one dorsal ray less.

Family BODIANIDAE.

Genus *Choerodon*, Bleeker, 1845.

Choerodon, sp. juv.

D. 13/7; A. 3/10. L. lat. 29; L. tr. 2/1/7.

Cheeks narrow. Maxillary not reaching eye. A confluent series of pointed teeth in each jaw. Two enlarged teeth near symphysis of upper jaw and about four near that of lower. Preoperculum with about a dozen serrations on its vertical limb. Opercles scaly and with a long and broad rounded flap.

Depth (5 mm.) 2·9 in standard length (14·5).

Lateral line continuous, not bent abruptly. Scales large, entire, leaf-like, not forming sheaths for fins.

Ventrals not reaching anal.

General colour yellowish with a green tinge on the fins. A dusky tinge on anterior portions of dorsal and anal, middle portion of ventrals, and base of lowest caudal ray. Tips of ventrals white. A large silver blotch on cheeks and another before pectoral base.

One small specimen (IA.4475) standard length 14·5 mm.; total length $\frac{3}{4}$ in.; found under a stone on reef flat, 6th September, 1928. This is evidently the greenish post-larval form of some species of *Choerodon*, but I am unable to identify it specifically.

Family Opisthognathidae.

Genus *Tandya*, Whitley, 1930.

Tandya maculata (Alleyne and Macleay).

Opisthognathus maculatus, Alleyne and Macleay, Proc. Linn. Soc. N.S.W., I, February, 1877, p. 280, pl. ix, fig. 3; Palm Is., N.Qd. ("Chevert" Expedition).
Batrachus punctatulus, Ramsay, Proc. Linn. Soc. N.S.W. VIII, 19th June, 1883, p. 177; Torres Strait, N.Qd. Type (I.1254) in Australian Museum, Sydney. Name emended to *B. punctulatus* by authors.
Gnathypops maculatus, McCulloch, Rec. W. Aust. Mus., I, 1914, p. 216.
Gnathypops maculata, Ogilby, Mem. Qd. Mus. VII, 30th June, 1920, p. 27, pl. iii (description and figure of Aru I. specimen).
Tandya maculata, Whitley, Mem. Qd. Mus. X, 1930, p. 19.

A large female from Low Isles (IA.4051) compared with the type of *Batrachus punctatulus* in the Australian Museum.

Range.—North Australia, Queensland, and Aru Islands.

Family Parapercidae.

Genus *Parapercis*, Bleeker, 1863.

Parapercis cylindrica (Bloch).

Five specimens (IA.4450–2) of this common Queensland fish from Low Isles. D. v/21; A. i/17; teeth on vomer and palatines.

Family Callionymidae.

Genus *Callionymus*, Linnaeus, 1758.

Callionymus calliste, Jordan and Fowler.

Callionymus calliste, Jordan and Fowler, Proc. U.S. Nat. Mus. XXV, 1903, p. 954, fig. 8; Misaki, Japan.

Head and anterior part of body strongly depressed. A pair of granulated raised occipital areas behind eyes. Preopercular spine with three large hooks above and an antrorse barb below. Interorbital very narrow. Four dorsal spines, connected by

membrane to their tips, the first longest, nearly equal to distance from posterior orbital border to tip of snout. Soft dorsal separate, with eight simple rays, the last one divided to its base, longer than last anal ray, and reaching to base of upper caudal ray. Anal originating below first dorsal ray, with seven rays, similar to those of dorsal. P. 18; V. i/5. Ventral membrane covering bases of lower pectoral rays.

General colour sandy brown on back, with irregular mottlings formed by closely grouped blackish punctulations or with creamy spots partly enclosed in dark crescentic borders. Ventral surface plain whitish or yellowish. A series of ill-defined fuscous cross-bars on body and a row of dark spots on sides below lateral line. Two upright dark stripes on cheek and another on each pectoral base. All fins speckled blackish except anal, which is plain. A row of larger spots on lower half of caudal and a cream spot at root of that fin. Some cream and black spots on ventrals and a larger black spot near tip of longest ray.

Described from a small specimen (IA.4463), 32 mm. in standard length or $1\frac{5}{8}$ in. in total length, from Batt Reef, Queensland. This is evidently a young female of *Callionymus calliste*, Jordan and Fowler, the only major differences between my specimen and the account of that species being eye longer than snout and about one-third length of head, last dorsal ray longer than last anal ray, and caudal more rounded. A similar specimen (IA.4630) from Low Isles.

New record for Australia.

Specimens identified as *Callionymus microps*, Günther, from Michaelmas Cay are quite different from *C. calliste*, being plumper and much darker in colour.

Callionymus japonicus scaber, McCulloch, from Lord Howe Island, *C. lunatus*, Temminck and Schlegel, and *C. valenciennesii*, Temminck and Schlegel, from Japan, were included by error in a key to the Australian species of *Callionymus* by McCulloch (Biol. Res. Endeavour, V, 1926, pp. 195–196). None of these species is yet certainly known from Australian waters.

Family Salariidae.

Key to Australian Genera of the Subfamily Salariinae.

A. A row of cirrhi crossing the neck to the opercular lobes . . . *Cirripectus*, Swainson, 1839.

A.A. No such row of cirrhi, but a single tentacle may be present on each side of the nuchal region.

B. Each side of mandible with a row of small teeth; no canines . . . *Ecsenius*, McCulloch, 1923.

B.B. Each side of mandible either toothless or with a single canine.

C. Dorsal fin not incised between spines and rays. Canines very small or absent . . . . . . *Salarias*, Cuvier, 1816.

C.C. Dorsal fin incised between spines and rays. Canines usually present.

D. Seventeen dorsal and nineteen anal rays . . *Negoseartes*, Whitley, 1930.

D.D. Nineteen or more dorsal and anal rays.

E. Upper lip crenulated . . . . . *Crenaltieus*, Whitley, 1930.

E.E. Upper lip entire . . . . . *Rupiscartes*, Swainson, 1839. (Syn. "*Alticus*" [Comm.], Lac., 1800).

Genus *Salarias*, Cuvier, 1816.

Salarias fasciatus lineolatus, Alleyne and Macleay.

Blennius fasciatus, Bloch, Naturgesch. ausl. Fische, II, 1786, p. 110, pl. clxii, fig. 1; East Indies and Japan.
Salarias lineolatus, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, March, 1877, p. 336, pl. xiii, fig. 2; Darnley Island, Queensland.
Salarias fasciatus, McCulloch, Rec. Aust. Mus. XIV, 1923, p. 123, pl. xv, fig. 3; Two Isles, Qd.

In his original account and figure, Bloch gives D. 29 and A. 19. The Queensland form of this species has D. xii–xiii/18–19; A. ii/19–20. A comparison of McCulloch's figure with that of Bloch shows marked differences in pattern and the vent midway between forehead and tail in the Australian form, which may be known subspecifically by Alleyne and Macleay's name.

Four (IA.4438–4440) from Low Isles; western moat, 9th September, 1928, and on reef flat, 14th September.

Genus *Negoscartes*, Whitley, 1930.

Negoscartes irroratus (Alleyne and Macleay).

One (IA.4441) Low Isles; another specimen (IA.4013) collected in General Survey. This is the type-locality of this species.

Genus *Crenalticus*, Whitley, 1930.

Crenalticus meleagris (Cuvier and Valenciennes).

Ten (IA.4442–3) from Low Isles; one specimen (IA.4014) collected in General Survey at Three Isles.

Two (IA.4444) from Snapper Island.

The type probably came from north-western Australia or Timor, so that Queensland forms may prove to be subspecifically distinct; in this case a new name may be required.

Genus *Rupiscartes*, Swainson, 1839.

Rupiscartes lineatus (Cuvier and Valenciennes).

One (IA.4437) from amongst rocks, the boulder track, Low Isles, 4th September, 1928.

Subfamily *Petroscirtinae*.

Genus *Petroscirtes*, Rüppell, 1830–1.

Petroscirtes hypselopterus, Bleeker.

Petroscirtes hypselopterus, Bleeker, Natuurk. Tijdschr. Ned. Ind. VIII, 1855, pp. 393, 399 and 423; Amboina.

This species, obtained at Low Isles, has not hitherto been recorded from Australia.

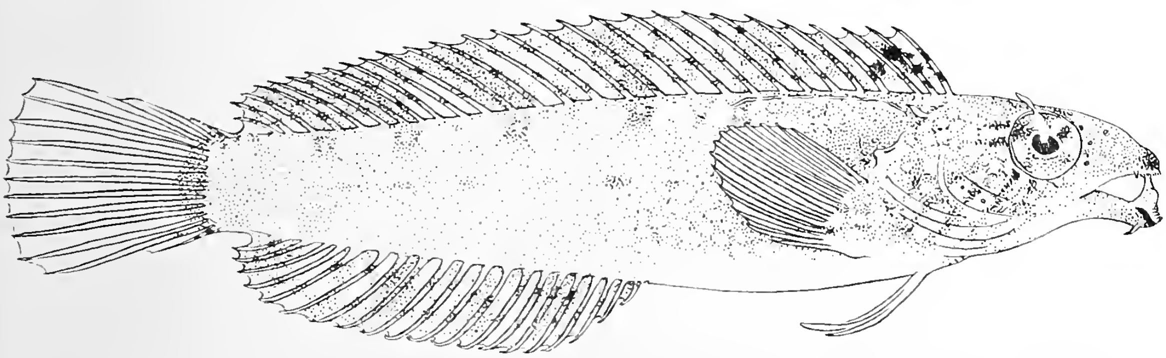
D. iii/23 ; A. i/5 ; V. 3 ; P. 15 ; C. 11. Jaws each with a single series of immovable incisors and large lateral canines.

Branched tentacles over eye, other smaller tentacles on cheeks, around chin. Maxillary extending to below anterior third of eye. Interorbital concave, half diameter of eye, which is equal to snout. Gill-opening small, above pectoral base.

Body naked ; lateral line almost obsolete, near back. Depth 4 in standard length. Head 3·7 in same.

Anterior three dorsal spines elevated and separated from the rays by a notch. Caudal rounded.

Ground-colour yellowish, densely marbled with black and brown to form a complicated marmorated pattern. Head and breast white-spotted. Two from Low Isles (IA.4445–6).



TEXT-FIG. 5.—*Petroscirtes viperidens* (De Vis). A specimen from Batt Reef. Regd. no. IA.4896. Drawing by Gilbert P. Whitley.

Petroscirtes viperidens (De Vis).

Salarias viperidens, De Vis, Proc. Linn. Soc. N.S.W. IX, 29th November, 1884, p. 697. Somerset, Cape York, Queensland. Types in Queensland Museum ; co-types in Australian Museum ; De Vis, Proc. Roy. Soc. Qd. II, 1886, p. 59.

Petroscirtes viperidens, McCulloch and McNeill. Rec. Aust. Mus. XII, 4th February, 1918, p. 23.

The accompanying figure is from a Batt Reef specimen (IA.4896), which has the following characters : D. 28 ; A. 20 ; P. 13 ; V. 3 ; C. 11.

Depth (10 mm.) 4·8, head (14) 3·4 in standard length (48). Eye (3·5) a little less than snout (3·7) and 4 in head.

A small tentacle over each eye and another on each side of the nape ; a small flap on each side of the chin.

General coloration, various shades of brown, disposed in markings as shown in the the figure. Belly plain. A dusky band across the base of the otherwise hyaline caudal fin.

Two others (IA.4447) from Batt Reef. Identified by comparison with co-types in the Australian Museum. Distinguished from *P. hypselopterus* by the much smaller tentacles, low dorsal spines, longer body, and lighter coloration, with plain belly.

Family Batrachoididae.

Genus *Coryzichthys*, Ogilby, 1908.

Coryzichthys diemensis (Le Sueur).

One specimen (IA.4482) from Low Isles. Eastern Australian forms with the throat mottled may represent a distinct subspecies, *C. diemensis queenslandiae* (De Vis), with *C. guttulatus*, Ogilby, as a synonym.

Family Eleotridae.

Genus *Calleleotris*, Gill, 1863.

Subgenus *Gergobius*, Whitley, 1930.

Calleleotris (*Gergobius*) *taeniura* (Macleay).

One specimen (IA.4345) from Low Isles, the type-locality.

Calleleotris (*Gergobius*) *muralis* (Cuvier and Valenciennes).

Eleotris muralis, Cuvier and Valenciennes, Hist. Nat. Poiss. XII, March, 1837, p. 253, pl. ccclvii; Tukopia, Santa Cruz Archipelago (Quoy and Gaimard).
Eleotris lineata, Castelnau, Vict. Offic. Rec. Philad. Exhib. 1875, p. 24; Cape York, Queensland.
Eleotris nigrifilis, Ogilby, Proc. Linn. Soc. N.S.W. XXI, 31st May, 1897, p. 754. New name for *Eleotris lineata*, Castelnau, regarded as anticipated by *Dormitator lineata*, Gill, 1863; Cape York, Queensland.
Valenciennea aruensis, Ogilby, Proc. Ry. Soc. Qd. XXIII, 7th November, 1910, p. 21; Aru Is.
Valenciennea muralis, McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 216, pl. xxxvii, fig. 4, and as *V. lineata* on p. 264.
Calleleotris muralis and *lineata*, McCulloch, Mem. Aust. Mus. V, 1929, p. 367.

One (IA.4346) from Low Isles. Under stones, 16th September, 1928.

Eleotris lineata, Castelnau, and *E. nigrifilis*, Ogilby, are obviously synonyms of this species.

Genus *Asterropterix*, Rüppell, 1830–1.

Asterropterix semipunctatus quisqualis, subsp. n.

The Queensland fish, the type of which has been described and figured by Ogilby (Mem. Qd. Mus. III, 1915, p. 125, pl. xxix, fig. 2), is hereby separated subspecifically from the typical *Asterropterix semipunctatus*, Rüppell, Atlas zu der Reise im N. Afrika (Senckenb. Nat. Ges.), 1830–31, p. 138, pl. xxxiv, fig. 4, from the Red Sea, on account of its fewer dorsal rays, and the lower spinous dorsal and ventral fins.

Six (IA.4347) from Low Isles, where the species is not so common as it is in other places on the Great Barrier Reef.

Genus *Eviota*. Jenkins, 1903.

Eviota viridis queenslandica, subsp. n.

Allogobius viridis, Waite, Rec. Aust. Mus. V, 11th March, 1904, p. 177, pl. xxiii, fig. 3; Lord Howe Is. Types in Aust. Mus., Sydney.

Eviota viridis. McCulloch, Rec. Aust. Mus. IX, May, 1913, p. 386 (Great Barrier Reef locs.); Waite, Trans. Roy. Soc. S. Aust. XL, 1916, p. 454; McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 260; Whitley, Aust. Zool., IV, 1926, p. 234 (North-West Islet, Qd.), and Rec. Aust. Mus. XVI, 1927, p. 27 (Michaelmas Cay, Qd.): *op. cit.* XVI, 1928, p. 302 (Hoskyn I., Qd.); Fowler, Mem. Bishop. Mus. X, 1928, p. 395.

Compared with typical specimens of *Eviota viridis* from Lord Howe Island, the Queensland form of this species is easily distinguished by its darker general coloration, large spots on head and two dark spots, which may be diffuse, on pectoral base. For this reason I name the Great Barrier Reef subspecies *Eviota viridis queenslandica*, the holotype being a specimen (IA.4068) from Batt Reef. This species is common in coral, and will probably be found to be separable into different subspecies from separate geographical areas. Specimens in the Australian Museum from the New Hebrides resemble the Queensland form in facies, whilst the Samoan *Eviota zonura*, Jordan and Seale (Bull. U.S. Bur. Fish, XXV, 1905 [15th December, 1906], p. 396, fig. 75), is apparently another subspecies. The described species of *Eviota* are evidently closely allied, and have bristle-like branches on the ventral and lower pectoral rays and naked nuchal region. The latter character is the main one for distinguishing *Eviota* from *Trimma*, Jordan and Seale (*loc. cit.*, pp. 381 and 391).

At Low Isles a few specimens of the new subspecies were secured (IA.4093, 4338).

Family Gobiidae.

Genus *Gobius*, Linnaeus, 1758.

Istigobius, subgen. nov.

Genotype *Gobius* (*Istigobius*) *stephensoni*, sp. n.

Distinguished from the true Palaearctic genus *Gobius* (type *G. niger*, Linnaeus) by its strongly contrasted colour pattern, larger scales, and longer caudal peduncle.

Gobius (*Istigobius*) *stephensoni*, sp. n.

Gobius maculatus, Castelnau, Vict. Offic. Rec. Philad. Exhib. 1875, p. 20; Queensland. Name preoccupied by *G. maculatus*, Nardo, Isis, XX, 6th June, 1827, p. 475.

Gobius ornatus, McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 227, pl. xxxiii, fig. 2. Murray Island specimen is type of *G. stephensoni*. Not *G. ornatus*, Rüppell, 1830–1; Whitley, Rec. Aust. Mus. XVI, 1927, p. 28 (Michaelmas Cay, etc.), and of Australian authors.

The Queensland form of *Gobius ornatus*, Rüppell, was named *Gobius maculatus* by Castelnau, but this name was preoccupied by *G. maculatus*, Nardo, and may now be

replaced by *Gobius stephensoni*, named in honour of Dr. T. A. Stephenson of London University. This species is allied to the North-West Australian *Gobius interstinctus*, Richardson (Zool. Voy. "Erebus" and "Terror," Fish, 1844, p. 3, pl. v, figs. 3–6), but differs from Richardson's description and figure in having free upper pectoral rays, and ground-colour lighter in tone. The holotype of *Gobius stephensoni* is the specimen from Murray Island described and figured by McCulloch and Ogilby.

Fourteen (IA.4350) from Low Isles, where the species was common. Others seen at Snapper Island.

Genus *Bathygobius*, Bleeker, 1878.

Bathygobius fuscus darnleyensis (Alleyne and Macleay).

? *Gobius fuscus*, Rüppell, Atlas zu der Reise im N. Afrika (Senckenb. Nat. Ges.), Fische, 1830–31, p. 137; Red Sea.

Gobius darnleyensis, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, March, 1877, p. 331, pl. xii, fig. 1; Darnley I., Queensland.

Gobius nigripinnis, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, March, 1877, p. 332, pl. xii, fig. 2; Palm Island, Queensland. Preoccupied by *G. nigripinnis*, Cuvier and Valenciennes, Hist. Nat. Poiss. XIII, 1837, p. 101.

Gobius marginalis, De Vis, Proc. Linn. Soc. N.S.W. IX, 29th November, 1884, p. 686; Cape York, Queensland.

Mapo fuscus, McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 231, pl. xxxiii, fig. 3; Darnley I., Torres Strait.

Four small specimens (IA.4430) and one larger one (IA.4431) from Low Isles.

Gobius nigripinnis, Alleyne and Macleay, is preoccupied, but *G. darnleyensis*, of the same authors, has page-priority, and is available for the Queensland form of *Bathygobius fuscus*.

Genus *Metagobius*, Whitley, 1930.

In this genus the ventral fins are only united by a small basal membrane and the scales are larger and the body shorter than in *Callogobius*, Bleeker.

Metagobius sclateri (Steindachner).

One from Low Isles (IA.4348) swimming with the ventral fins separated. The original description of this species is not available to me but, on zoogeographical grounds, it seems reasonable to suppose that the North Queensland form may not be identical with the typical Tahitian one; in which case a new name would have to be proposed for the Australian species.

Genus *Amblygobius*, Bleeker, 1874.

Amblygobius phalaena (Cuvier and Valenciennes).

A female in roe (IA.4349) from Low Isles.

Yongeichthys, gen. nov.

Genotype, *Gobius criniger*, Cuvier and Valenciennes.

Body robust, compressed, covered with large ctenoid scales, which become cycloid on the breast and the base of the pectoral. Head entirely naked, with lines of mucigerous pores crossing the cheeks and opercles, and large open pores above the nostrils, on the interorbital space, along the nuchal groove, and around the preopercular margin. Snout obtuse, the profile convex. Jaws subequal. Mouth a little oblique; no barbels. A band of villiform teeth in each jaw, and an outer series of enlarged ones; a subcaniniform tooth may be present on each side of the mandible. Tongue subtruncate, free anteriorly. Gill-openings lateral, the isthmus broad. Exposed edge of shoulder-girdle smooth. Pseudobranchiae present. Gill-rakers short, thick, about five on lower limb of first branchial arch. Dorsal with six spines and about ten rays. Anal similar to soft dorsal. Pectoral rounded, its upper rays not free. Ventrals large, united, with a broad basal membrane. Caudal rounded.

Equivalent to *Rhinogobius*, McCulloch and Ogilby, 1919, *non* Gill, 1859.

The genotype of *Rhinogobius*, Gill, 1859, is the Japanese *R. similis*, which has a larger mouth and higher dorsal than the Queensland species. *Fusigobius*, Whitley, 1930, has a more pointed head and different fin-outlines. The genus *Ctenogobius*, Gill, 1858, is West Indian and need not be considered here: *Coryphopterus*, Gill, 1863, is also a New World genus. The filiform dorsal spine and the large lateral blotches of *Gobius criniger* apparently distinguish it from *Porogobius*, Bleeker, 1874, and the colours and formulae of *Gobius schlegeli*, Günther, from the Gold Coast, the genotype of *Acentrogobius*, Bleeker, 1874, show that none of the genera associated with the "*Rhinogobius*" of Australian authors can be used for this species. It is therefore necessary to erect a new genus with *Gobius criniger*, Cuvier and Valenciennes, as type.

Named in honour of Dr. C. M. Yonge, leader of the Great Barrier Reef Expedition.

Yongeichthys criniger (Cuvier and Valenciennes).

Gobius criniger, Cuvier and Valenciennes, Hist. Nat. Poiss. XII, March, 1837, p. 82; Port Dorey, New Guinea (Quoy and Gaimard).

Gobius festivus, De Vis, Proc. Linn. Soc. N.S.W. IX, 29th November, 1884, p. 687; Cape York, Queensland (Broadbent).

Rhinogobius nebulosus, McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 245: not *Gobius nebulosus*, Forskål, Descr. Anim. 1775, p. 24, from the Red Sea.

The Queensland fish called *Rhinogobius nebulosus* by Jordan and Seale, McCulloch and Ogilby, and Australian authors, would more appropriately assume the specific name of *Gobius criniger* supplied by Cuvier and Valenciennes, as its fin-counts differ from those of *Gobius nebulosus*, Forskål.

A specimen of *Yongeichthys criniger* (IA.4351) was found in a shallow pool amongst mangroves, 10th September, 1928. Others were seen entering burrows in the mud which had been made by crustaceans. One fish might enter several burrows in succession. It would protrude its head from a hole and wait and watch for several minutes, then, flicking a puff of sand, would swim away.

Yongeichthys leftwichi (Ogilby).

Rhinogobius leftwichi, Ogilby, Proc. Roy. Soc. Qd. XXIII, 7th November, 1910, p. 24; Great Sandy Strait, Queensland; McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 248, pl. xxxiv, fig. 3 (topotype).

One (IA.4354), near mangroves, Low Isles, 29th August, 1928.

Genus *Priolepis*, Cuvier and Valenciennes, 1837.

Priolepis, Cuvier and Valenciennes, Hist. Nat. Poiss. XII, March, 1837, p. 67. *Ex* Ehrenberg MS. Genotype, *P. mica* (Ehr.) Cuvier and Valenciennes, a Red Sea variety of the Pacific *Gobius semidoliatus*, Cuvier and Valenciennes.

Zonogobius, Bleeker, Arch. Néerland Sci., IX, 1874, p. 323. Genotype, *Gobius semifasciatus*, Kner (*fide* Jordan, Gen. Fish. III, 1919, p. 374).

Priolepis, Cuvier and Valenciennes, should replace *Zonogobius*, Bleeker. In his Genera of Fishes, Jordan (p. 373) remarked that Bleeker, in his Esquisse (1874), which is not available to me, made *Priolepis* equivalent to *Asterropteryx*, Rüppell, but Cuvier and Valenciennes' brief account suggests that *Priolepis* is distinct, as the characteristic bands are mentioned and these are not present in *Asterropteryx*. Hemprich and Ehrenberg figured *Priolepis micans* in their Symbolae Physicae, which I have not seen, and Boulenger (Zool. Rec., 1899 [1900], p. 24) notes the identity of this species with *Gobius semidoliatus*, Cuvier and Valenciennes.

Priolepis nuchifasciatus (Günther).

Three specimens (IA.4355) from Low Isles. Very sluggish, and may be caught by hand.

Beetroot-red in life as in Herre's figure of *Z. semidoliatus* (Monog. Philipp. Bur. Sci. XXIII, 1927, pl. xxx, fig. 2), but this colour fades away after death. McCulloch, in manuscript, noted the life-colours of Masthead Island specimens as " scarlet, brightest on the head, which is marked with thin bluish-white, dark-edged lines. Scales dark-edged. Dorsals, caudal, and anal with several rows of scarlet spots." The late Dr. W. E. J. Paradice noted the colours of Cumberland Islands specimens (IA.2377) as follows :

> " Locality : Cumberland Is., Great Barrier Reef. Blown up in three fathoms near rocks. At a distance the small fish appears reddish brown all over, but considerably lighter in the pectoral region than elsewhere. On close examination it is seen that each scale has an almost colourless centre and is outlined with reddish brown. The head is reddish brown with the brown predominating whilst in the tail the red predominates, the transition of colour being gradual and uniform. No outlines of scales can be detected by the naked eye anterior to the origin of the dorsal fin, and the head is marked by several white transverse bands, the edges of which are clearly defined by a line of brown slightly darker than the ground-colour of the head. The unpaired fins (including tail) have zig-zag lines of reddish brown crossing a colourless ground. The pectorals are almost colourless and the ventrals brown with a white edge."

Subfamily *Gobiodontinae*.

Genus *Gobiodon*, Bleeker, 1856.

Gobiodon unicolor (Castelnau).

Ellerya unicolor, Castelnau, Proc. Zool. Acclim. Soc. Vict. II, 10th May, 1873, p. 95; Eclipse I., Cape Sidmouth, Queensland.

Ellyria (*sic*), Castelnau, Offic. Rec. Philad. Exhib. Melb. 1875, p. 21.

Gobiodon verticalis, Alleyne and Macleay, Proc. Linn. Soc. N.S.W. I, March, 1877, p. 333, pl. xii, fig. 4. No locality (= Darnley I., Qd.). Types in Macleay Museum, University of Sydney; McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 208, pl. xxxii, fig. 2 (Green I., Qd.); Whitley, Rec. Aust. Mus. XVI, 1927, p. 28 (Michaelmas Cay, Qd.).
Gobius douglasi, Saville-Kent, Gr. Barrier Reef, 1893, p. 310, chromo-pl. xvi, fig. 12; Thursday I., Qd.

Two specimens (IA.4066) from Batt Reef agree with Castelnau's description; his name has precedence over *G. verticalis*, Alleyne and Macleay. The types of the latter came from Darnley Island, not New Guinea as stated by authors. This species is common amongst coral on the Great Barrier Reef.

Genus *Paragobiodon*, Bleeker, 1873.

Paragobiodon echinocephalus gibbosus (Macleay).

Gobius echinocephalus, Rüppell, Atlas zu der Reise im N. Afrika (Senckenb. Nat. Ges.) Fische, 1830 *vel* 1831, p. 136, pl. xxxiv, fig. 3 (*ex* Ehrenberg MS.); Massowah, Red Sea.
Gobius gibbosus, Macleay, Proc. Linn. Soc. N.S.W. V, 20th May, 1881, p. 601; Endeavour R., Queensland. Type in Macleay Museum, University of Sydney.
Gobius scabriceps, Macleay, Proc. Linn. Soc. N.S.W. V, 10th May, 1881, p. 603; Endeavour R., Queensland. Type in Macleay Museum, University of Sydney.
Paragobiodon echinocephalus, McCulloch and Ogilby, Rec. Aust. Mus. XII, 1919, p. 239, pl. xxxiv, fig. 1 (references and synonymy); Whitley, Aust. Zool. IV, 1926, p. 205, and Rec. Aust. Mus. XVI, 1927, p. 28; Herre, Monog. Philipp. Bur. Sci. XXIII, 1927, p. 172, pl. xiii, fig. 2 (Philippines); Whitley, Rec. Aust. Mus. XVI, 1928, p. 301; Fowler, Mem. Bishop. Mus. X, 1928, p. 399.

A common species amongst coral, and very variable in colour. In several parts of Queensland I have noted its preference for *Seriatopora hystrix*, and observed this also at Batt Reef.

Five (IA.4067 and IA.4462) from Batt Reef.

Family PERIOPHTHALMIDAE.

Genus *Euchoristopus*, Gill, 1863.

Euchoristopus kalolo (Lesson).

A few specimens (IA.4352–4343) of this common mangrove fish were preserved for identification. I am using Lesson's specific name, which has priority over that of Cuvier and Valenciennes.

On 27th May, 1770, this species was observed by members of the crew of the "Endeavour" in what is now Queensland (Hawkesworth, Account Voy. S. Hemisph., ed. 1, 1773, III, p. 529), and no visitor to the tropical mangrove swamps can fail to be impressed by this interesting fish.

Family Scorpaenidae.

Subfamily *Scorpaeninae.*

Genus *Sebastapistes,* Streets, 1877.

Sebastapistes bynoensis laotale, Jordan and Seale.

Sebastapistes laotale, Jordan and Seale, Bull. U.S. Bur. Fish, XXV, 15th December, 1906, p. 376, fig. 72; Apia, Samoa.
Sebastapistes bynonesis, Whitley, Rec. Aust. Mus. XVI, 1927, p. 29; Michaelmas Cay, Qd.

Two specimens (IA.4435–4436) from Low Isles; caught by Mr. F. W. Moorhouse, 29th September, 1928.

Subfamily *Pteroinae.*

Genus *Brachirus,* Swainson, 1839.

Brachirus, Swainson, Nat. Hist. Fish. Amphib. Rept. II, July, 1839, p. 71 = *Brachyrus,* Swainson, *ibid.,* p. 264. Genotype, *B. zebra* (Cuvier and Valenciennes) (= *Pterois zebra,* Quoy and Gaimard), selected by Swain, Proc. Acad. Nat. Sci. Philad. 1882 (1883). p. 277. Not *Brachirus,* Swainson, *ibid.,* pp. 187 and 303, a genus of Soles.
Dendrochirus, Swainson, Nat. Hist. Classif. Fish. Amphib. Rept. II, July, 1839, p. 180, *Genus caelebs.* Genotype, *Pterois zebra,* Cuvier and Valenciennes (= Quoy and Gaimard), designated by Jordan and Evermann, Bull. U.S. Fish. Comm. XXIII, 1903 (1905), p. 465.

As *Brachirus* is apparently not preoccupied or otherwise invalidated, it must take precedence over *Dendrochirus.*

Brachirus zebra (Quoy and Gaimard).

One small specimen (IA.4434) was caught at Low Isles 1st September, 1928.

Genus *Pterois,* Schinz, 1822.

Pterois volitans (Linné).

Noted from Low Isles by Yonge (A Year on the Great Barrier Reef, 1930, p. 96), but not seen from that locality by the writer.

Family Synancejidae.

Genus *Synanceja,* Bloch and Schneider, 1801.

Synanceja trachynis, Richardson.

(Plate IV, figs. 1, 2).

For the taxonomy, synonymy, and bibliography of this species, see my Ichthyological Miscellanea (Mem. Qd. Mus. X, 1930, p. 25). Probably the "*Batrachus*" of MacGillivray (Narr. Voy. "Rattlesnake," I, 1852, p. 198) is referable to this species.

D. xiii/7; A. iii (rudimentary)/6; P. 16; V. i/5; C. 9 main branched rays.

Head, measured from symphysis of upper jaw to opercular flap (95 mm.), 2·2 in standard length (209). Depth, at origin of dorsal (90), 1·2 in width at opercles (109). Eye (9) 2·6 in width of supraorbital bosses (24). Ventral fin (50) nearly equal to pectoral base (52). Depth of caudal peduncle (22) 1·5 in length of caudal (34).

Head about as broad as long, but longer than deep. A shield-shaped nuchal bony process with two smaller similar approximate crests adjoining a diamond-shaped depression on each side of the nape. A deep saddle-shaped concavity between dorsal fin and eyes, over each of which there is an excrescence where the frontal bones form a supraorbital boss. A deep concavity above and between the eyes. Upper surface of snout subhorizontal. Below each eye, over the cheek, there is a deep hemispherical depression. Preopercular stay produced into a large bony knob below each eye. A series of bony ridges along each preorbital which ends in two sharp processes, the anterior of which is covered by a fleshy lobe.

Preopercular margin rounded, with five or six lobes and a large flesh-covered spine. Opercular margin oblique, lobed, with a blunt flap superiorly and a projecting rounded bony inferior process.

Gill-openings wide, separated by a broad isthmus. Branchiostegal membranes covered with fatty tissue. Four gill-arches; no slit behind the fourth. A series of close-set rudimentary gill-rakers like papillae.

Cleft of mouth almost vertical, gape wide. Premaxillary arc-shaped, its width subequal throughout its length. Maxillary with a broad truncate margin and the angles rounded. A concavity on each side between chin and mandible. A band of small, close-set, pointed teeth in each jaw, separated by a fleshy process at each symphysis. A velar flap in both jaws. An inconspicuous patch of teeth on the vomer but none on palatines. A large oval patch of teeth, on each side, above and below, before the pharynx; the lower patches are in advance of the upper, and bear smaller teeth. Tongue broad and fleshy, with a rounded margin. Head covered with a thick skin, without scales. The skin is produced into fimbriae around the mouth, and gives rise to wart-like protuberances on opercles and chin.

Body rounded anteriorly, compressed posteriorly, and with a bag-like belly. The skin is thick, wrinkled and with large wart-like processes, which are largest on the back and sides, and not nearly so plentiful under the pectoral. The thick skin extends over the fins and almost obliterates many of the rays. There is a row of warts along each side of the dorsal and one wart on each side of the root of the tail; other warts occur on the upper surface of the pectorals.

Dorsal originating vertically over preopercular spine. The first three spines are long, spaced, and slightly distinct from the remaining ten. Each spine is sharp and provided with a venom-sac on each side, but all but the tip of each spine is concealed by thick skin which is noticeably lobed on the anterior spines. Second dorsal short, but with the median rays longer than any of the spines. The last dorsal ray is connected to the caudal peduncle by a thick membrane which is just distinct from the caudal. Anal with three rudimentary spines like fleshy fingers; soft portion of fin similar to soft dorsal, and connected to the caudal peduncle in the same way, but more anteriorly. Pectorals broad and muscular, with the skin of the under-surface smooth. The nine lowest rays are thick and like curved fingers, but the uppermost rays are branched and almost hidden

by the thick integument. Ventrals stumpy, with a long base; the rudimentary spine and first two or three rays are finger-like, and a broad membrane connected the fifth ray of each ventral fin to the belly. There are hardly any warts on or between the ventral fins. Caudal broad, regularly fan-shaped, with a rounded margin.

The general colour in formalin is rusty brownish, marbled with grey, which becomes the predominating colour on the top of the head and back, and on the larger warts. The greyish marbling tends to form bars or reticulations on the fins, which are of a darker brown towards their margin. There is a sea-green tinge suffusing the grey marbling on the bony prominences of the head and on the light ground-colour of the cheeks. A dark brown diamond-shaped concavity on the nape bears a superficial resemblance to an eye, as does also a brown patch in the hemispherical concavity below the true eye. Snout, jaws, and velar flaps in mouth spotted with brown. Interior of mouth white; bands of teeth yellowish.

Described and figured from a Stonefish nearly 10 in. long. Australian Museum registered number IA.4057.

This specimen has already figured in popular articles on the Great Barrier Reef Expedition*; it was collected on the reef near the mangroves at Low Isles under the following circumstances which are described in my field notes:—

24th September, 1928: I was about to turn over a piece of coral when something between it and a gaping clam attracted my attention. This object was so like a piece of eroded rock that I had to examine it closely before realizing that it was in reality a stonefish. I touched it with a stick and the three anterior dorsal spines were erected immediately. The fish was absolutely still and its misshapen head, of a lemon-yellow colour in life, was pockmarked with grey, which heightened its resemblance to the yellowish madrepores from which its head and foreparts were protruding. The dorsal spines were yellowish, with their investing integument puckered into fronds and frills. The eyes had tiny black pupils surrounded by a variegated iris whose surface appeared pimpled. The hinder parts of the body and the thick pectorals were partly hidden, but appeared yellowish with reddish wart-like processes. The mouth was kept tightly shut, but I pushed it open with a piece of coral and noted the inside as white with blackish markings. Only the upper part of the gill-slit appeared to be opened and closed and that almost imperceptibly, a small current of water being ejected at intervals of about four seconds. The edge of the gill-slit was finely fimbriated so as to look as if fringed with algae. A photograph of this Stonefish, taken *in situ* by Mr. W. Boardman, is reproduced here.

Molluscs crawled over the stonefish's rock-like head and some prawns even walked over its mouth but the stonefish paid no attention to them. The head, body and fins were covered, as is usual in this species, with a thick coating of brown or greenish-brown slime. The specimen was netted and kept alive for some hours in a bucket of water, but it died overnight.

The colours of a specimen from Thursday Island (Austr. Mus. regd. no. IA.2046), sent to Sydney in ice, were noted as follows:

The dominant colours of this specimen are scarlet and grey which form an anastomosing pattern. The greater part of the head and back is grey, closely speckled with more or

* Tandy, Nat. Hist. Mag., London, II, 1929, p. 89, fig. 11; Whitley and Boardman, Aust. Mus. Mag. III, 1929, p. 369, with frontispiece and photo in text; Yonge, A Year on the Great Barrier Reef, 1930, p. 94, pl. xxix, fig. c. All these articles deal with the identical specimen.

less rounded spots, defined by darker lines around their edges. On the head the spots are largely brown above and red below, but on the back they are dark red anteriorly, changing to scarlet posteriorly. The sides of the body are principally scarlet, this colour being broken up by a grey, dark-edged, reticulating pattern. These colours become lighter below and change gradually into white on the belly. The sub-ocular cavity has a large black central spot, surrounded by others of lighter tint and separated by whitish lines; the whole bears some resemblance to a large eye. The cavity on each side of the occiput is black; another black blotch covers the base of the upper opercular spine, and less definite darker areas occur on the maxillary bone and between the preopercular spines. The dorsal fin is grey, with scarlet spots like the back, and a darker margin; the soft dorsal has a broad dark margin and is crossed obliquely by an irregular whitish streak. The anal fin is lighter basally, but is somewhat similar to the soft dorsal. Pectoral largely scarlet, with a dark purplish margin, and the whole fin is covered with numerous irregular whitish sub-reticulate lines. Caudal scarlet at base, changing to dark-purplish towards the margin, and is crossed by numerous white or grey lines with darker edges, of which a broad one across the middle of the fin is most conspicuous. Ventral yellowish basally, the rays scarlet, and the membrane between their tips dark purple; a series of broad white dark-edged spots crosses the rays about the middle of the fin, and there are several light circular spots. Gill membranes white. Chin and throat with grey and scarlet markings similar to the rest of the head. Inside of mouth pure white, but tinged with green on the inner surface of the lips.

Total length, 305 mm.

Genus *Synanceichthys*, Bleeker, 1863.

"*Spurco*," Cuvier and Valenciennes, Hist. Nat. Poiss. IV, November, 1829, p. 452; *ex* Commerson MS., non-binomial. One species (*Scorpaena brachion*, Lacepède, = *Synanceichthys verrucosus*).

Synanceichthys, Bleeker, Ned. Tijdschr. Dierk. I, 1863, p. 234. Type, *Synanceja verrucosa*, Bloch and Schneider (*fide* Jordan, Classif. Fish. 1923, p. 210).

Emmydrichthys, Jordan, Proc. Calif. Acad. Sci. (2), VI, 1st March, 1897, p. 221; *ex* Jordan and Rutter MS. Genotype, *E. vulcanus*, Jordan.

Deleastes, Seale, Occ. Pap. Bishop. Mus. IV, 1, 1906, p. 80. Genotype *D. daector*, Seale. Not *Deleaster*, Erichson, 1839, a genus of Coleoptera. Said to have "smaller ventrals, situated more posteriorly than in *Synanceia*, . . . skin smooth."

Synanceja, Jordan, Gen. Fish. III, 1920, p. 374. Type wrongly regarded as *S. verrucosus*. Not *Synanceja*, Bloch and Schneider, *sensu stricto*.

I follow Jordan in using *Synanceichthys* for this genus as I am unable to consult Bleeker's original definition (Ned. Tijdschr. Dierk. I, 1863, p. 234).

Synanceichthys verrucosus (Bloch and Schneider).

Mr. F. W. Moorhouse collected a Stonefish on Batt Reef which I identified as *Synanceichthys verrucosus*. It had the interorbital broad, deeply concave. Mouth broad. No prominent processes on preoperculum. Base of pectoral longer, head broader and caudal smaller than in the *Synanceja trachynis* from Low Isles. Chin broad. Ventrals reaching well towards anal. Pharyngeal teeth in large patches.

This Stonefish is apparently not nearly so common on the Great Barrier Reef as *Synanceja trachynis*.

Specimens are in the Australian Museum from—
Murray I., Queensland,
Suva, Fiji,
Malay Archipelago (Day Coll.), and
Bougainville I., Solomon Group.

Family PLATYCEPHALIDAE.

Subfamily *Inegociinae.*

Genus *Suggrundus,* Whitley, 1930.

Subgenus *Repotrudis,* Whitley, 1930.

Suggrundus (*Repotrudis*) *macracanthus* (Bleeker).

One specimen (IA.4344) dredged in 12 fathoms, off Low Isles, 16th, October, 1928, by Mr. A. A. Livingstone.

Family BALISTIDAE.

Genus *Balistapus,* Tilesius, 1820.

Subgenus *Rhinecanthus,* Swainson, 1839.

Balistapus (*Rhinecanthus*) *aculeatus* (Linnaeus).

Specimens (IA.1622) from Low Isles were collected by Dr. W. E. J. Paradice as well as by members of the Expedition (IA.4053, 4089, 4499). These agree in detail with the description of *Balistes aculeatus* by Linnaeus (Syst. Nat., ed. 10, 1758, p. 328). Other specimens are in the Australian Museum from Two Isles and Masthead Islet, Queensland; Port Moresby, Papua; Vanikoro, Santa Cruz Group; Vate and Aneiteum, New Hebrides; Samoa; Fiji; Bougainville Island, Solomons. This species is common in the coral waters of the Pacific.

Family OSTRACIIDAE.

Genus *Lactoria,* Jordan and Fowler, 1902.

Lactoria cornutus (Linnaeus).

One (IA.4500) caught whilst it was swimming around a block of *Porites* coral on Batt Reef, 13th September, 1928.

Family TETRAODONTIDAE.

Genus *Ovoides,* Anonymous, 1798.

"*Les Ovoïdes,*" Lacepède, Hist. Nat. Poiss. I, 1798, p. 520. Haplotype, "Ovoïde fascé" from "La mer des Indes." Vernacular name only.

Crayracion, Walbaum, Artedi, Ichthyol. (3), ed. 2, 1792, p. 580; *ex* Klein, non-binomial. Name not acceptable.

Ovoïdes, Anonymous. Allg. Lit. Ztg. (Jena), No. 287, 1798, p. 674 (*fide* Jordan, Classif. Fish, 1923, p. 240). Genotype, *Ovum commersoni*, Bloch and Schneider, by present designation.
Ovoides, Cuvier. Leçons Anat. Comp. I. 1800. Table IV. *nomen nudum*.
Ovum, Bloch and Schneider. Syst. Ichth., 1801, p. 530. Genotype, *O. commersoni*, Bloch and Schneider, based on " L'Ovoïde fascé " of Lacepède. Not *Ovum*, Martini, 1774, a non-binomial genus of mollusca (*teste* Mr. T. Iredale).
Oonidus, Rafinesque, Analyse de la Nature, 1815, p. 90. *Fide* Sherborn, Index Anim.
Ooides, Agassiz, Nomencl. Zool. 1846, Index Univ. Emend. pro. " Ovoïdes " Lacepède.
Crayracion, Bleeker, Atlas Ichth. VI, 1872, p. 49. Revival of a non-binomial name proposed by Klein, 1777. Genotype, *C. laevissimus*, Bleeker, based on Klein.

Tetraodon, Linnaeus (Syst. Nat.. ed. 10, 1758, p. 332, genus 165. Genotype, *T. lineatus*, Linnaeus [spelt " *Tetrodon* " by Linnaeus, 1766] from the Nile), has recently been restricted to fluviatile species. *Ovoides* is here used for the Indo-Pacific Puffer-fishes of the *stellatus* and *aerostaticus* group with the body spotted, and the distensible belly with dark stripes (at least in the young).

Ovoides aerostaticus otteri, var. n.

(Plate III, fig. 2.)

Tetraodon aerostaticus, Jenyns, Voy. " Beagle," Fish, 1842, p. 152. Locality unknown. Said to have no lateral line ; Jordan and Seale, Bull. U.S. Bur. Fish, XXV, 1906, p. 368.
Crayracion lineatus, Bleeker, Atlas Ichth. V, 1872, p. 70, pl. ccvi, fig. 1, and pl. ccxii, fig. 1 (plates published 1865); East Indies. Not *Tetrodon lineatus*, Linnaeus, 1758, from the Nile.
Tetrodon stellatus, Günther, J. Mus. Godeffroy, VI, 17 (Fische de Südsee, IX), 1910, p. 465, pl. clxvi, fig. B. Gesellschafts Ins. Not *T. stellatus*, Bloch and Schneider, 1801, from Mauritius.

One (IA.4494), 101 mm. in standard length, from Batt Reef, agrees in general features with Bleeker's figure on pl. ccvi, and differs from Jenyns' description in having a well-marked lateral line system. *Tetrodon amabilis*, Castelnau (Proc. Linn. Soc. N.S.W., III, 1879, p. 401), is a distinct species from New South Wales characterized by its orange ground-colour. In *Tetraodon calamara*, Rüppell (Atlas zu der Reise im N. Afrika [Senckenb. Nat. Ges.], Fische, 1829, p. 64, pl. xvii, fig. 1 : Red Sea), the eye is about 3 in snout whereas it is only about 2 in the Batt Reef specimen. As the Queensland form is evidently unnamed, I have much pleasure in associating the name of Mr. Guy Otter, one of the Zoologists of the Expedition, with this novelty.

Colours when Fresh.—Back dark brown, lighter on sides and becoming whiter on the belly, which is tinged with yellow ochre ventrally. Head, back, sides and tail densely sprinkled with blackish spots, which are smallest on the back and largest on the tail. The belly is streaked with broad irregular black markings. Gill-opening bluish black and each pectoral fin surrounded by a black ring. Pupil bluish, iris coppery. Dorsal and anal fin-rays smoky yellowish. Some parts of sides darker than others. Vent surrounded by a black spot. Lips greyish.

Ovoides implutus (Jenyns).

? *Tetraodon hispidus*, Linnaeus, Syst. Nat. ed. 10, 1758, p. 333. Based on Chin. Lagerstr. 23 and Artedi, gen. 58, syn. 83 : India.
Tetrodon implutus, Jenyns, Zool. Voy. " Beagle," Fish, 1842, p. 152 ; Keeling Islands.
Crayracion laterna, Bleeker, Atlas, Ichthy. VI, 1865, pl. ccv, fig. 3 ; *ibid.*, 1872, p. 71, as *C. implutus*.
Tetraodon hispidus, McCulloch, Mem. Aust. Mus. V, 1929, p. 428, and of Australian authors generally.
Tetraodon, Yonge, A Year on the Great Barrier Reef, 1930, p. 88, pl. xxix, fig. A (Low Isles, Qd.).

Great Barrier Reef specimens in the Australian and Queensland Museums have no arc-shaped markings around eyes and have the cheeks and chin with light spots on a dusky ground, agreeing with Bleeker's figure, but not with any in Day's Fishes of India.

Two specimens (IA.4492, 4493) from Low Isles. This species can move either eye independently of the other ; it does not unfold the caudal fin very much when swimming, thereby resembling the Aluterid fishes.

Ovoides manillensis (Procé).

Tetrodon manillensis, Procé, Bull. Soc. Philom., Paris, September, 1822, p. 130 ; Manila, Philippine Is.
Tetraodon immaculatus, Jordan and Seale, Bull. U.S. Bur. Fish. XXV, 1906, p. 370 (references). Not *T. immaculatus,* Bloch and Schneider, 1801.

Three (IA.4495, 4496 and 4497) from Low Isles, where the species was common. Body striped and with prickles capable of penetrating the hand in contrast to the almost smooth integument of *O. implutus.* Future study, with more specimens, may show that the two species should be subgenerically separated.

INDEX

DESCRIPTION OF PLATE I.

FIG. 1.—*Himantura granulata* (Macleay). A living specimen among mangrove roots at Low Isles. Australian Museum registered number IA.4477. Photograph by William Boardman.

FIG. 2.—*Actinicola percula* (Lacepède). A specimen swimming amongst the tentacles of a large sea-anemone (*Stoichactis*). The arrows in the margin point towards the fish. Photograph by William Boardman.

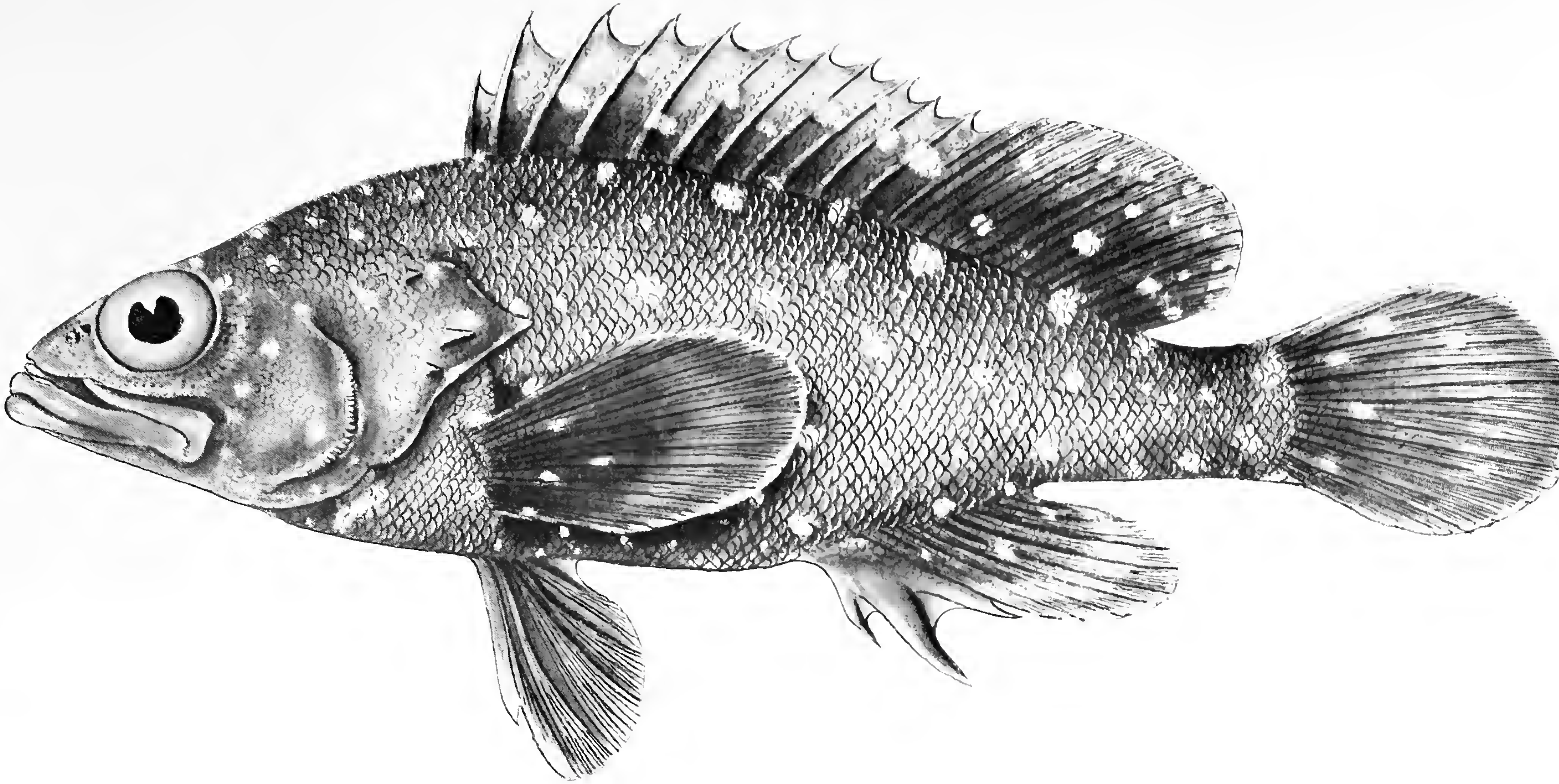
FIG. 1.

FIG. 2.

Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE II.

FIG. 1.—*Epinephelus hoevenii* (Bleeker). A specimen from Low Isles. Regd. no. IA.4426. Drawing by Miss Joyce K. Allan.



[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE III.

Fig. 1.—*Equula obscura* (Seale). A specimen from Low Isles. Regd. no. IA.4498. Drawing by Joyce K. Allan.

Fig. 2.—*Ovoides aerostaticus otteri*, var. n. Holotype of variety from Batt Reef. Regd. no. IA.4494. Drawing by Joyce K. Allan.

PLATE III.

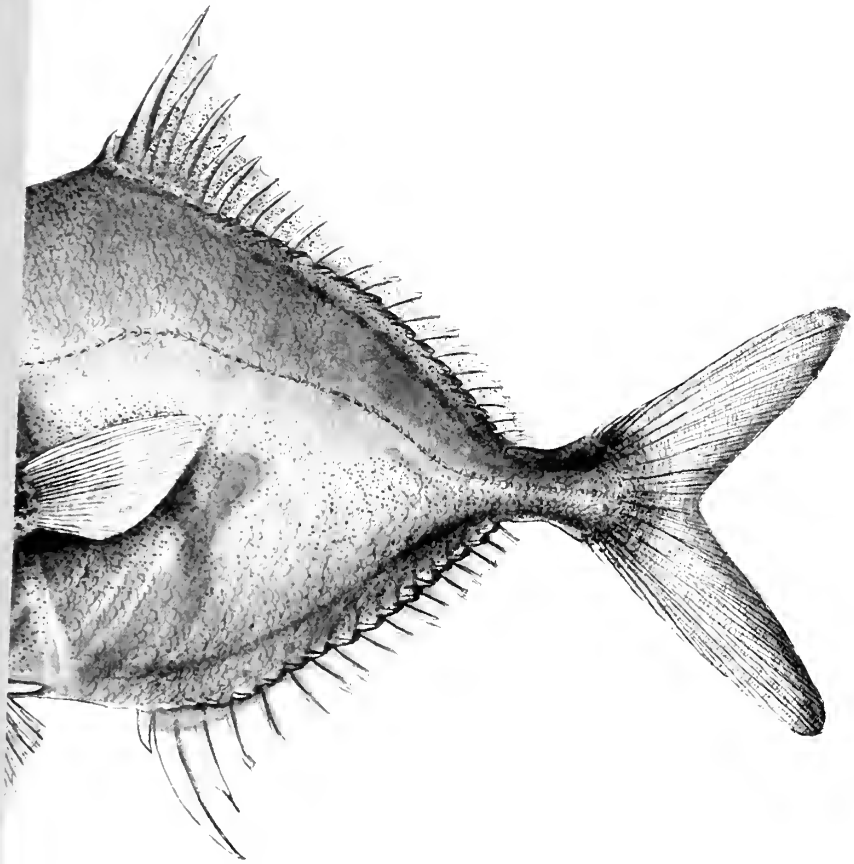


FIG. 1.

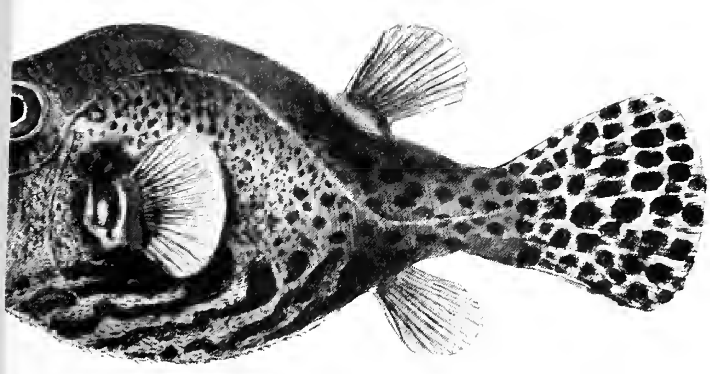


FIG. 2.

[Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE III.

Fig. 1.—*Equula obscura* (Seale). A specimen from Low Isles. Regd. no. L
K. Allan.

Fig. 2.—*Ovoides aerostaticus otteri*, var. n. Holotype of variety from Batt
Drawing by Joyce K. Allan.

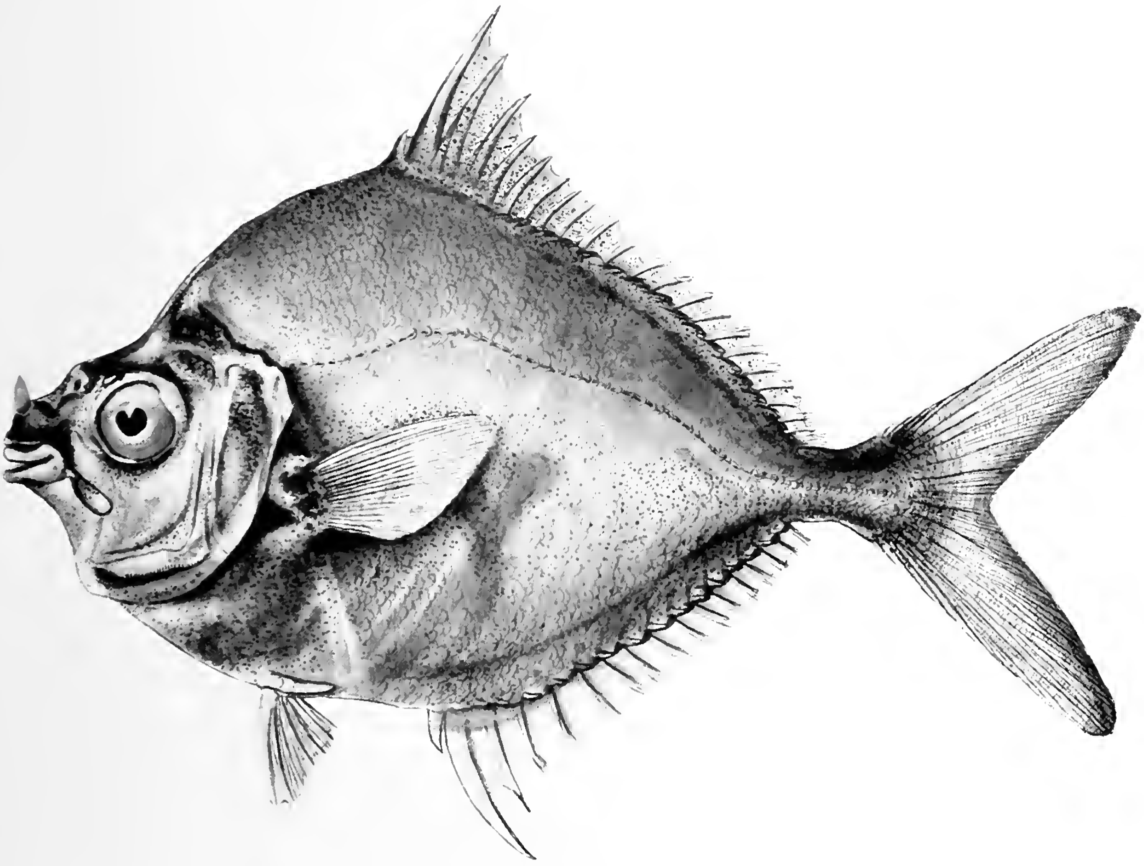


FIG. 1.

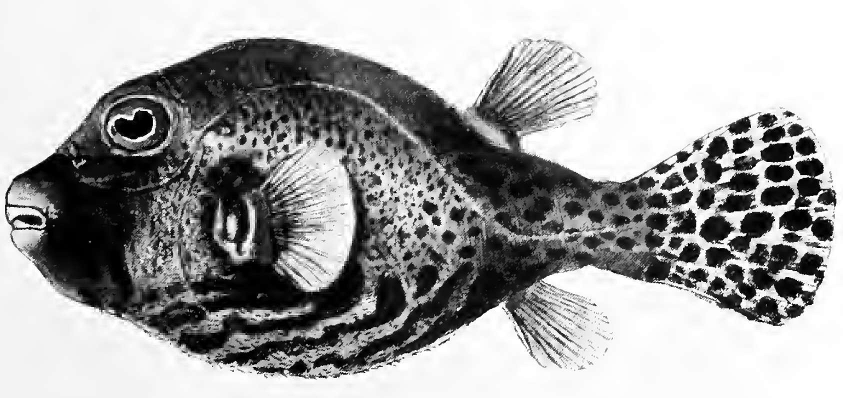


FIG. 2.

[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE IV.

Fig. 1.—*Synanceja trachynis*, Richardson. Living specimen *in situ* amongst corals, a horseshoe clam, and other objects, showing its remarkable resemblance to its surroundings, in the moat at Low Isles. The arrows in the margin point towards the fish. Photograph by William Boardman.

Fig. 2.—*Synanceja trachynis*, Richardson. The same specimen as in fig. 1 removed from its natural surroundings. Low Isles. Regd. no. IA.4057. Photograph by William Boardman.

FIG. 1.

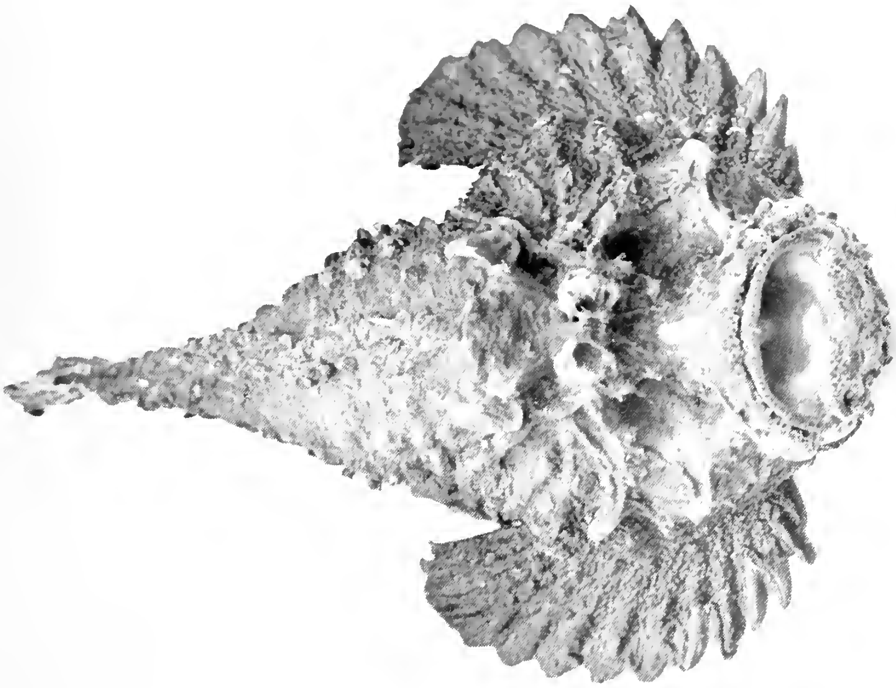


FIG. 2.

[*Adlard & Son, Ltd., Impr.*

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 10

SIPHONOPHORA

BY

A. K. TOTTON, M.C.,
(*Assistant Keeper in the Department of Zoology*)

WITH THIRTY-SIX TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1932

Price Five Shillings

[*Issued 25th June, 1932*]

SIPHONOPHORA

BY

A. K. TOTTON, M.C.,
Assistant Keeper in the Department of Zoology

WITH THIRTY-SIX TEXT-FIGURES

CONTENTS

1. INTRODUCTION.

THIS report deals with the Siphonophora only from the systematic point of view. Their occurrence and distribution in the region of the Great Barrier Reef will be discussed in detail in the general reports on the zooplankton which are in preparation by Mr. Russell and Mr. Colman.

A remarkable fact about the Siphonophora is that, in spite of their individual abundance in all seas, the total number of known species is only about 120, made up of 40 Physophorae, 60 Calycophorae, 12 Rhizophysaliae, and 8 Chondrophorae. Of these, 4 Physophorae and 25 Calycophorae were taken by the Expedition. In addition two new species are published, and the capture of four unnamed species is recorded.

Some points to which attention is invited are the discussion of the taxonomic value of Monophyism ; the suggested regrouping of the Sphaeronectids ; some general notes on the nomenclature and classification of Prayids, and on the classification of certain Galeolariids ; the erection of a new genus *Lensia* for a group of small forms like *Galetta subtiloides* ; and a new and more natural grouping of species of *Diphyes*.

It is often difficult to identify from published figures and descriptions the detached parts of colonies which continue to lead an active, free existence, and are often found free in the plankton. It has been thought desirable, therefore, to record fully the shapes of the various bracts and swimming bells brought back by the Expedition.

It is regretted that it has been found necessary to give up the use of the names *Galeolaria* and *Cuboides*, and to introduce such new names as *Chelophyes* and *Lensia*, as well as to reintroduce the old names *Sulculeolaria*, *Enneagonum* and *Eudoxoides*.

Terminology has been reviewed recently by Moser (1925), but I regret that I cannot adopt all her proposals. Since all the nectophores of polygastric stages of Calycophorae appear to be homologous structures, it is as well to use the same terms throughout for comparable parts. I therefore retain the term " dorsal " for the abaxial, and " ventral " for the axial side of the mouth of the nectosac of all such nectophores. Moser, who regards the inferior or posterior nectophore as a sterile gonophore and not a homologue of the anterior one, calls the abaxial side of one nectophore of a Prayid or Diphyid " dorsal " and that of the others " ventral." On the other hand, I agree with Gegenbaur, Huxley, Chun, and Bigelow in regarding the nectophores as homologous structures.

About the use of the terms " right " and " left " there is a difficulty. Having adopted the convention of calling the " abaxial " side of a nectophore " dorsal," and knowing that its apex is directed towards the aboral end of the whole organism, there should be no ambiguity about " right " and " left." Unfortunately the convention has been adopted by both Bigelow and Moser of viewing a nectophore from the dorsal side with aboral end uppermost, and applying the term " right " to the side opposite the right hand of the observer. Since Moser applies the term " dorsal " to that side of the posterior nectophore which Bigelow calls " ventral," there is no uniformity even in present usage. In the present report the term " dorsal " is used for the " abaxial " side of all nectophores, and " right " and " left " are employed in the morphological sense, assuming the apical end of a nectophore to be the aboral one. Thus if a Diphyid, with somatocyst uppermost, is momentarily swimming in a horizontal position towards the north, the eastern side of its anterior nectophore and the western side of its posterior nectophore is the right side ; for it is swimming with its aboral end foremost, and with the " dorsal " side of the posterior and " ventral " side of the anterior nectophore uppermost.

In describing eudoxids I have been consistent in the use of the same terms for homologous structures. Moser (1925) uses the terms " headpiece," " neck-shield," and " suture "* (Kopfstück, Nackenschild, Naht), which supply good points of reference. The surface opposite the " suture " she refers to as dorsal, and I have followed her in this throughout ; so that it is easy to understand what she means by the statement that the edge of the left side of the neck-shield is a continuation of the left sutural ridge.† But in her description of *D. bojani* the dorsal side of the bract becomes the " Oberfläche " and the sutural surface the " Innensiete." In this I have not followed her. In *D. mitra* and *D. spiralis* the left side of the bract is termed by Moser the " right ventral " and the sutural surface the " left ventral," whilst the left edge of the sutural surface becomes the " ventral ridge." Here again I have not followed her practice, preferring to use throughout only one term for each structure. I adopt the convention of calling the abaxial side of the gonophore the " dorsal " one.

* The " suture " is the surface of the bract which lies next to the stem or axis. There is nothing in the nature of a suture about it in its development.

† I say that the right side is a continuation of the right ridge because the apex of the bract is the aboral end.

The term "basal" is applied to the oral, and "apical" to the aboral end of a nectophore or gonophore.

It had been hoped when the collection was first taken in hand that the tow-nettings would include material of all stages of development of such common forms as *Diphyes chamissonis*, but although prolonged and careful search has been made, only four diphyid larvae about three-quarters of a millimetre in length have come to light so far. They are referred to under *D. chamissonis*.

Most of the plankton hauls were made inside the edge of the Great Barrier Reef. Six stations were taken in the deep oceanic water outside the Barrier edge, and a few in intermediate positions.

The number of published observations on the behaviour of living Siphonophores is very small, but a study of the available accounts, such as those of Vogt (1854), and more recently of Berrill (1930), shows of what great importance in the animals' economy is the fishing-line apparatus of the tentacles. Evolutionary progress appears to have been in the direction of forming cover for this and other appendages when not in use, and providing for increased rapidity of retreat from enemies. I regret to have had little opportunity for studying living Siphonophores. A few observations which I have been able to make are mentioned later.

Species of six families belonging to two suborders were taken. The suborders Rhizophysaliae and Chondrophorae are not represented at all.

2. LIST OF SPECIES.

PHYSOPHORAE.

Agalmidae.

1. *Agalma okenii*, Eschscholtz.
2. *A. elegans* (Sars).
3. *Agalma*, sp. indet.
4. *Stephanomia bijuga* (Delle Chiaje).
5. *Cordagalma cordiformis*, gen. et sp. nov.

Forskaliidae.

6. *Forskalia*, sp.

CALYCOPHORAE.

Prayidae.

7. *Rosacea ? plicata*, Quoy and Gaimard.
8. *Amphicaryon acaule*, Chun.

Hippopodiidae.

9. *Hippopodius hippopus* (Forskål).

Abylidae.

10. *Abyla haeckeli*, Lens and Van Riemsdijk.
11. *Abylopsis tetragona* (Otto).
12. *Enneagonum hyalinum*, Quoy and Gaimard.
13. *Abylopsis eschscholtzii* (Huxley).
14. *Bassia bassensis* (Quoy and Gaimard).

Diphyidae.

15. *Sulculeolaria quadrivalvis* (Blainville).
16. *S. monoica* (Chun).
17. *Galetta chuni* (Lens and Van Riemsdijk).
18. *G. turgida* (Gegenbaur).
19. *Diphyes dispar,* Chamisso and Eysenhardt.
20. *D. bojani* (Chun).
21. *D. chamissonis,* Huxley.
22. *Chelophyes appendiculata* (Eschscholtz).
23. *Eudoxia russelli,* sp. nov.
24. *C. contorta* (Lens and Van Riemsdijk).
25. *Eudoxoides mitra* (Huxley).
26. *E. spiralis* (Bigelow).
27. *Dimophyes arctica* (Chun).
28. *Lensia subtiloides* (Lens and Van Riemsdijk).
29. *L. subtilis* (Chun).
30. *L. campanella* (Moser).
31. *L. fowleri* (Bigelow).
32. *Lensia,* spp. indet.

3. DESCRIPTION OF SPECIES.

Physophorae.

Agalmidae.

Two " Athorybia " larvae of Agalmids have been picked out of the catches, a larger one 2·5 mm. in length, with eight bracts, taken in an open vertical haul of the Nansen net from 180 m. outside Trinity Opening on 20th October; and a smaller one 1·1 mm. in length, with four bracts, taken nearby on the same day in a similar vertical haul from 250 m. to the surface. As the larvae are not in very good condition no attempt will be made to describe them. The bracts have three longitudinal ridges on the upper side, a small terminal saccule and a deep excavation on the lower or inner side. The angle between their two sides forms what might be described as another ridge on either hand.

Five species of Agalmids have fully grown representatives in the collection. Of three species, including *A. elegans*, there are only a few small loose nectophores. Two of them cannot at the moment be identified with any known species, but their form and the run of their lateral canals are in each case quite characteristic. One is regarded as the genotype of a new genus *Cordagalma.*

Agalma, Eschscholtz, 1825.

(?) *Cuneolaria,* Eysenhardt, 1821 [in Chamisso and Eysenhardt, 1821, p. 369].

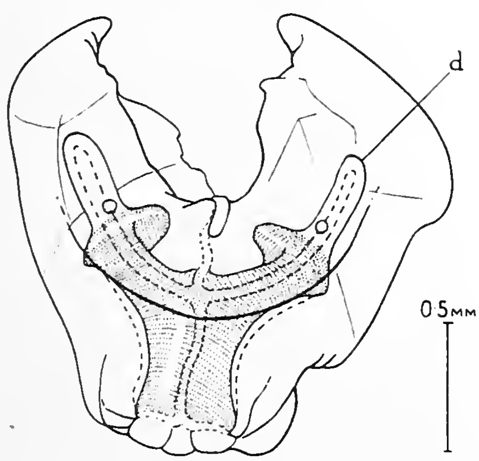
Bigelow (1911*b*), the last reviser of the genus, recognized four species of *Agalma*—*A. okenii*, Eschscholtz, *A. elegans*, Sars, *A. clausi*, Bedot, and *A. haeckeli*, Bigelow (=*A. eschscholtzi*, Haeckel). It may be possible to recognize and distinguish the last two in the field, but at any rate Bedot's figures do not appear to me to be sufficiently good to make

possible the identification of detached nectophores. If Haeckel's figures of the nectophore of *A. haeckeli* be correct, it can be at once distinguished by the direct, unlooped, lateral radial canals, and the shape of the bracts is diagnostic.

Bigelow (1911*b*), who has had the opportunity to study a large series of living specimens of *Agalma okenii*, states that "in very small specimens" the bracts associated with the oldest siphon are unlike those found on older specimens, in having only two facets. Some young specimens brought back by the expedition bear young bracts showing the transition between the two- and the four-facet stages.

Agalma okenii, Eschscholtz, 1825.

Five young specimens measuring from 3 mm. to 15 mm. in length were taken in the tow-nets. Medium-sized nectophores have on each side of the mouth an oblique dorso-lateral facet, divided from a triangular facet by a ridge opposite the end of the horn of



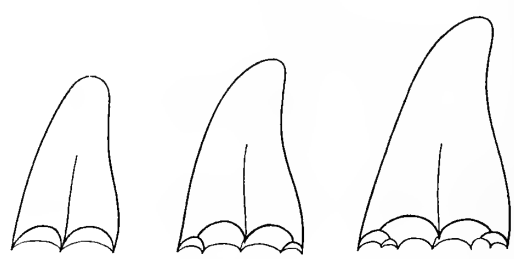
TEXT-FIG. 1.—*Agalma okenii*, Eschscholtz. × 34. Young nectophore showing the diverticulum, *d*, of the lateral radial canal ascending over the lateral horn of the nectosac.

the nectosac. In older nectophores this triangular facet becomes divided into two by a second ridge, but it is clearly absent in young nectophores. In fact, the young nectophores of this species closely resemble the adult nectophores of *A. elegans*, and may be said to pass through an "*elegans*" stage. The ends of the horns of the nectosac are broadened obliquely—a feature not shown by Bigelow (1911*b*) in pl. 17, fig. 12. Viewed from the ventral surface—that is, the side turned towards the stem and the posterior end of the specimen—the course of the lateral canal is as follows: Starting from the pedicular canal, it runs outwards along the aboral and inner margin of the arm of the nectosac, to pass away obliquely over the middle of its broadened end. It then makes a semicircular sweep on the lateral wall of the nectosac-arm or horn towards its dorsal edge, loops down to its ventral edge at a point about midway between mouth and tip of arm, runs back obliquely on to the ventral side of the nectosac, where it appears as a loop, and finally runs up, obliquely, to the dorso-lateral side of the mouth of the nectosac.

In the smaller nectophores the loop made by the lateral radial canal on the ventral side is relatively much smaller, and the transverse ridge is often absent from the oblique dorso-lateral facet. In some of the smaller, not fully developed nectophores there is on

each side a large upstanding diverticulum of the lateral radial canal as much as 0·22 mm. in length and 0·15 mm. in diameter, at the point where it crosses the apex of the nectosac arm. These diverticula become absorbed later on, but often leave vestiges. Distally to this diverticulum the canal is not looped in the earliest phase of a growing nectophore. One of the distinguishing features of this species is the faceted bract.

The bracts taken with the youngest specimen are of two kinds, some shorter, 3·3 mm. in both length and breadth, and two longer, up to 6·6 mm. in length. Each kind is enantiomorphic. In both there are two asymmetrical main facets, but in the smaller ones there is a small subsidiary distal facet on the edge, which cuts off the distal end of one of the lateral ridges. In the largest bract from Station 49 there are two of these subsidiary facets. I have observed two similar facets, subsidiary to the usual four, as a constant character in *A. okenii*, though I have seen no mention of them in published accounts. Bigelow (1911*b*) figures one such facet with its two cusps on the extreme edge of the bract, just above the " 10 " of fig. 10, pl. 17, and the cusps of its fellow on the other side, but makes no mention of them in the text. There is one attached immature bract of the shorter type about 0·75 mm. in length which has rudiments of a subsidiary facet on each side.



TEXT-FIG. 2.—*Agalma okenii*, Eschscholtz. Diagram of three successive growth-stages of a bract to show the origin of secondary and tertiary facets on the distal edge.

In the accompanying text-figure can be traced the development of the mature bracts with three series of facets. In the first stage there is a single pair. The second and third pairs arise as flattenings of the outer and intermediate cusps.

Agalma elegans (Sars, 1846).

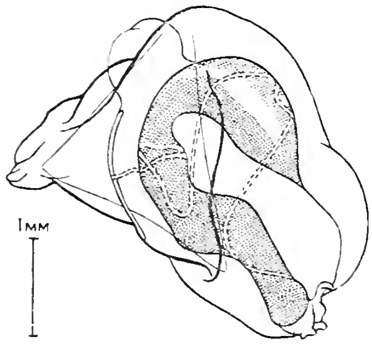
Four small nectophores 2 mm. in width from a vertical haul at St. 28, outside Trinity Opening, 23rd November, 1928. In the shape of the nectosac and run of the radial canals they agree with Bigelow's (1911*b*) pl. 19, figs. 2–3, which are characteristic of the species.

Agalma, sp. indet.

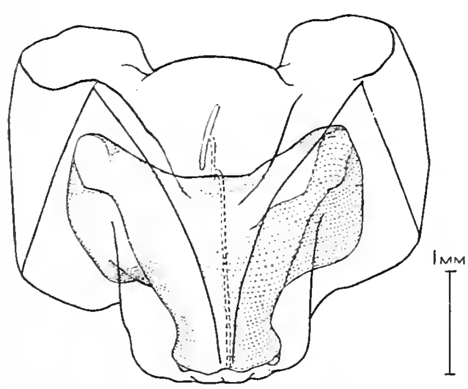
Six detached nectophores, the largest measuring 4·8 mm. in width, 3·5 mm. from the oral to aboral side, and 2·9 mm. dorso-ventrally ; taken in a vertical haul of the stramin net from 400 m. to the surface outside Papuan Pass on 18th March.

The shape of the nectosac and run of the radial canals are the same in all six nectophores, and differ distinctly from the arrangement found in *A. okenii*, *A. elegans*, *A. haeckeli* and *A. clausi*.

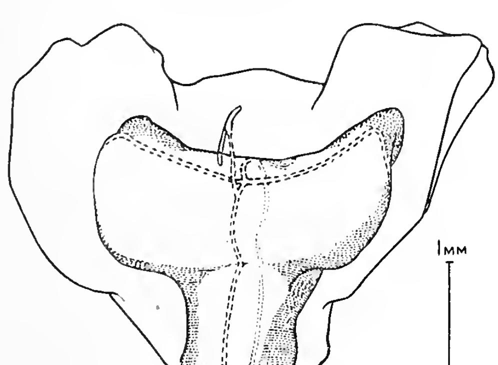
The lateral wedges of the nectophores, which probably belong to a young specimen, are not so drawn out and flattened as are those of other known species at an equivalent age, but nevertheless have the same arrangement of lateral facets. The nectosac is



TEXT-FIG. 3.—*Agalma*, sp. indet. × 13. Lateral view of a nectophore to show the region of attachment, and the course of the lateral canal.



TEXT-FIG. 4.—*Agalma*, sp. indet. × 13·5. Dorsal view of a nectophore to show the shape of the nectosac.



TEXT-FIG. 5.—*Agalma*, sp. indet. × 15. Ventral view of a nectophore to show the pedicular and radial canals.

relatively deeper dorso-ventrally, occupying more of the volume of the nectophore. The pedicel is not nearly so long as in *A. okenii*. This character is best appreciated when a lateral view is taken. The ventral wall of the nectosac is relatively deep dorso-ventrally, and forms a gentle concave curve from side to side. There is on each side a deep oblique

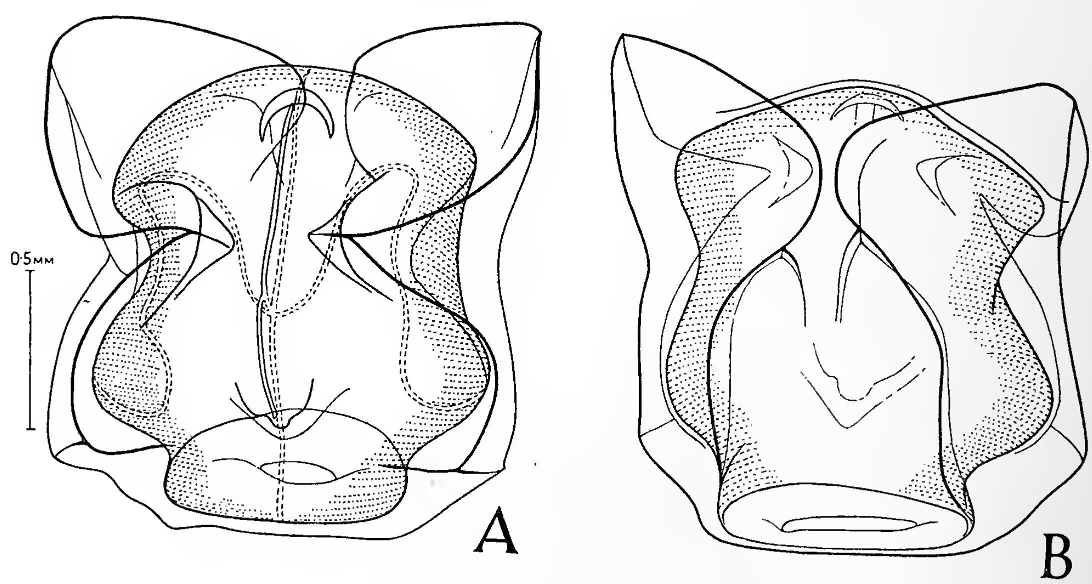
dorso-ventral expansion or horn of the nectosac. The transverse ventral wall does not curve away in a broad sweep towards the lateral side of the horn at this point as in *A. okenii*. Instead there is a distinct ridge between the ventral and lateral walls of the nectosac.

The course of the lateral radial canals is characteristic. From their junction with the pedicular canal they run out horizontally to the middle of the ridge on the lateral horns, and after a slight upward bend turn down and run to its ventral end. Each lateral radial canal then curves up to form a large vertical loop that covers the dorso-lateral surface of the nectosac. The descending limb of the loop passes just over on to the ventral surface before running up to the side of the mouth, but does not form what might be described as a ventral loop.

A series of special terms would be needed for an adequate and concise description of the various surfaces and angles of the nectophore and nectosac, and of the loops of the radial canals. At the present moment this extended description, illustrated by text-figures, will suffice to indicate the points in which these nectophores differ from those of previously described species. The nectophores of the various species seem to be highly characteristic, and a closer study of their morphology would facilitate the identification of material.

Stephanomia bijuga (Delle Chiaje, 1842).

This species occurred sparingly at both inside and outside stations, as well as intermediately throughout the year, although there were no records of it for the months February, May, August and September.



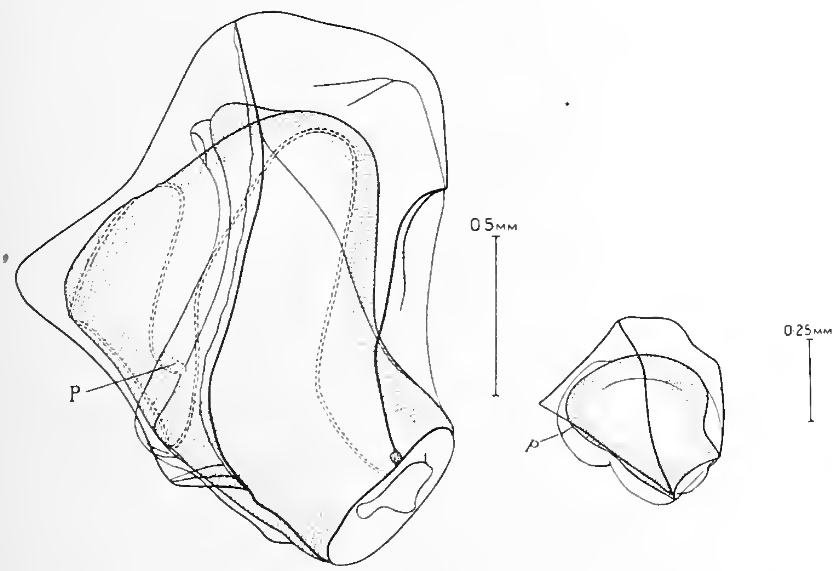
TEXT-FIG. 6 —*Stephanomia bijuga* (Delle Chiaje). × 42. A, Ventral view of a young nectophore to show the region ot attachment, and the pedicular and radial canals ; B, dorsal view of the same to show the ridges.

Only five complete specimens were taken, varying in length from 2 mm. (an extended specimen) to 5 mm. (a contracted one). The greatest number of detached nectophores taken in one haul was twelve. The pneumatophores varied in size from 0·5 mm. to 3 mm.

in length and 0·3 mm. to 0·71 mm. in diameter. An extended specimen, 3·6 mm. in length, had a pneumatophore measuring 0·7 mm. in length and 0·3 mm. in diameter, and bore five nectophores (seven detached ones were present also) and four siphons.

The nectophores correspond with those of a specimen taken at Valentia Harbour, Ireland, by Miss Delap, and with figures given by Claus (1878) for *Halistemma tergestinum*, but differ from those figured by Bigelow (1911*b*), pl. 19, figs. 6 and 7, in that the junction of the radial canals with the pedicular is on a line drawn between the mouth and the tip of the lateral horn, so that the lateral radial canals make an ascending sweep on the inner side of the lateral horn of the nectosac. Bigelow's figure appears to show the origin of the pedicular canal at a point corresponding with the upper end of the semilunar muscular lamella.

The tentilla of the specimen from St. 37 are well preserved and distinctly unicornuate.



Text-fig. 7.—*Stephanomia bijuga* (Delle Chiaje). × 42. A, Lateral view of a young nectophore to show the course of one of the lateral radial canals ; B, the same view of a younger nectophore, to show the position of the pedicular canal, *p*.

Cordagalma, gen. nov.

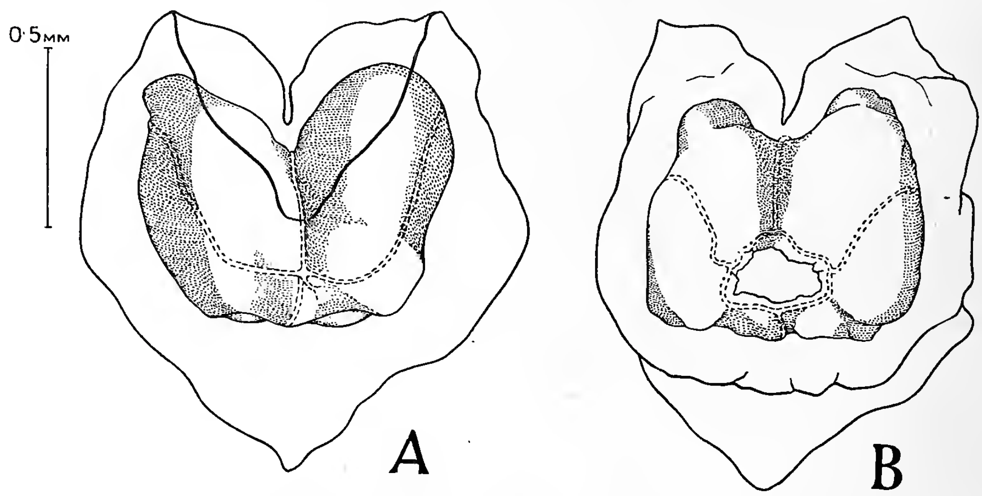
Genotype.—*Cordagalma cordiformis*, sp. nov.

This name is proposed for a genotype whose detached nectophores differ from those of any existing genera in being attached by their bases to the muscular lamellae. The upper limit of attachment does not reach the level of the upper, median wall of the nectosac, and the lower extends well down on to a pointed basal process of the nectophore. The lateral radial canals are comparatively simple and unlooped.

Cordagalma cordiformis, sp. nov.

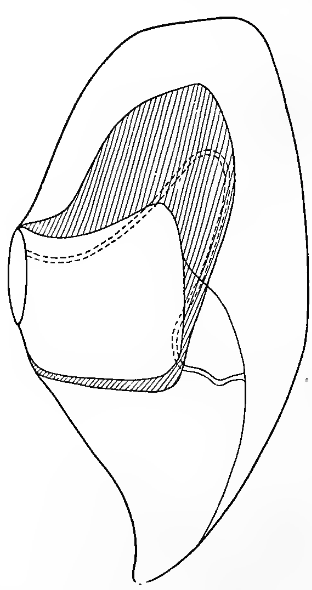
Six small nectophores, the largest measuring 2·5 mm. in length, 2·2 mm. in breadth, and 1·4 mm. in thickness from inner or ventral side to oral side, were taken in a vertical haul of the coarse silk net at St. 19 on 20th October.

The nectophores are not in a good state of preservation, but they agree with one another in several characteristics. Viewed from the oral or outer side they are shaped like the conventional heart with a point below and two rounded lobes above.



TEXT-FIG. 8.—*Cordagalma cordiformis*, sp. n. ×47. A, Ventral view of a nectophore to show the radial canals; B, dorsal view of the same.

The semilunar process is attached unusually low down the nectophore, the upper end not reaching the level of the upper, median wall of the nectosac, and the lower extending well down on to the pointed process below (Text-fig. 9). This at once distinguishes the nectophores from those of known species of *Agalma, Lynchnagalma, Anthemodes, Stephanomia, Nectalia, Physophora* and *Pyrostephos*. *Erenna* is not sufficiently well known for a description of its nectophore to be given.



TEXT-FIG. 9.—*Cordagalma cordiformis*, sp. n. Diagrammatic lateral view, showing one of the simple lateral radial canals. The horn of the nectosac is cross-hatched.

The junction of the pedicular and radial canals is nearly on a level with the base of the nectosac. The two lateral radial canals sweep upwards to form a semicircle on the

inner face of the nectosac. Each passes round the lateral horn some distance below its blind upper end and sweeps down without any secondary loops to the side of the mouth of the nectosac. The lateral horns themselves extend chiefly upwards, and are divided from one another by a sharp cleft. They extend only slightly round the stem. The nectophores indeed appear not to dovetail into one another as is usually the case, since there are no lateral triangular processes or wedges.

The nectophores of this species should be recognized again with ease; and it will be convenient for the present to give the species to which they belong the name *cordiformis*, and to make the species the genotype of the new genus *Cordagalma*. The six nectophores may be considered as parts of the holotype of the species.

I have since taken many small nectophores that correspond exactly with these off Kingstown, St. Vincent, B.W.I., at the surface at night in the month of February. I am still without a clue as to the species to which they belong, but they can be so easily recognized that they may be given a provisional name.

Foskaliidae.

Forskalia, sp.

Seven small loose nectophores 3 mm. in length, and a single bract measuring 4 mm. in length and 1 mm. in breadth, were taken in a vertical haul from 170 metres to surface at outside St. 50 on 18th March, 1929.

This was the only occurrence of any species of *Forskalia*. The condition of the specimens does not warrant a detailed description.

Calycophorae, Leuckart, 1854.

Although it is not proposed in this place to make a detailed criticism of the opinions on phylogeny expressed by Moser (1925), it is felt to be desirable at once to dissent from her conclusion that Calycophorae were the ancestors of the Physophorae. Moser considers the pneumatophores of the Physophorae to be altered swimming-bells of Calycophoran ancestors, but I consider them to be derived from primitive apical organs. The larval bells of the Calycophorae I regard as precociously developed homologues of the swimming-bells of the Physophorae.

Of the four families recognized by Bigelow (1911*b*), two, Prayidae, Kölliker, and Hippopodiidae, Kölliker, may be accepted as natural groups, but have only one and two representatives respectively in the collection. The third, Sphaeronectidae, Bigelow (=Monophyidae, Chun), does not appear to be a natural group, whilst the two subfamilies of the fourth, Diphyidae, I regard as separate families. The character on which alone the family Sphaeronectidae is founded is the presence of a single nectophore. There is evidence that such a condition has been brought about along several converging lines of evolution. The phenomenon, which may be referred to as monophyism, appears not only amongst the Diphyidae, but in the Abylidae as well. It will be seen, for instance, that *Enneagonum hyalinum* (=*Cuboides vitreus*) is an Abylopsid that has lost its second nectophore. It would only defeat the ends of a scheme of natural classification to name as a special group a heterogeneous collection of " Diphyids " (Dimophyidae, Moser, 1925) that included amongst other forms a species of *Diphyes* with a reduced posterior

nectophore (*Dimophyes arctica*), and an Abylopsid with none (*Enneagonum hyalinum*). As to Bigelow's two reasons for accepting Chun's group Monophyidae, there seem to be no grounds for assuming either that *Muggiaea*- and *Cuboides*-like forms gave rise to Diphyids and Abylids respectively, or that monophyism was ancestral.

I reject Chun's group because of the fact that after careful consideration of the sum of the characters of each Calycophoran species we can arrange them in natural groups or genera that contain species not only of one sort—polyphyid, diphyid or monophyid—but also that form any of the four combinations of these three kinds. It may be argued, therefore, that monophyism is not a character upon which alone to base conclusions as to natural relationship. For this reason I do not recognize as a single natural group an association of all the monophyid species. *Monophyes* and *Sphaeronectes* themselves may be neotenous forms retaining larval features rather than modern survivors of primitive adults, and for them the name " Sphaeronectidae " must be retained. The affinities of *Muggiaea* are with Diphyids ; and *Nectopyramis* is a Prayid.

The collection contains only one species included in the Sphaeronectidae of Bigelow, namely, *Enneagonum hyalinum*, and this is dealt with amongst the species of *Abylopsis*.

The main difference between Diphyidae and Abylidae is that while the Diphyids would appear, from the comparative sizes of the two nectosacs, to use the anterior one as their chief propulsive organ, the Abylids, as a rule, use the posterior nectosac almost exclusively. In fact I have observed that *Abylopsis tetragona* only uses the anterior sac intermittently, and then possibly for changing direction. The difference might be more accurately expressed by saying that whereas the Abylids have, as a rule, reduced their first formed bell and relied on the propulsive effort of the second, the Diphyids have entirely discarded it, but made use of a smaller third one. Two of the Abylopsids, however, appear to have struck out in a direction rather different from that taken by other Abylids. *A. eschscholtzii* has a reduced posterior nectophore, and *Enneagonum* or *Cuboides* has entirely lost it. Nevertheless, certain members of both families, Diphyids and Abylids, starting presumably from a stage of evolution comparable with that of the Prayids, have after following these diverging paths reached the same point and have become " monophyids " ; but *D. spiralis* has become a small, stream-lined, active darter, whilst the larger, unwieldy *Enneagonum hyalinum* is probably not able to do much more than counteract the force of gravity. It would be most interesting to know how this curious species actually does behave.* We are tempted, then, as pure speculation, to suppose that the ancestral Physophore, with its numerous rapidly pulsating bells driving the colony along in a direction at right angles to the axis, was succeeded by forms like Prayids with a reduced number of bells which probably progressed in line with the axis ; and that in turn arose forms like the Galeolariids and Diphyids with two bells staggered one behind the other, whose propulsive efforts reinforced one another, and the Diphyids, able to draw the stem under cover and increase their speed of escape from enemies. The posterior bell of some was at last found to be a drag and discarded. Meanwhile the ancestral Abylids found it a good plan to drive with the second bell and change direction with the first. The acquisition of this new function of the first bell led to its development on novel lines again in the Abylopsids, and culminated in its exclusive use in such a form as *Cuboides*.

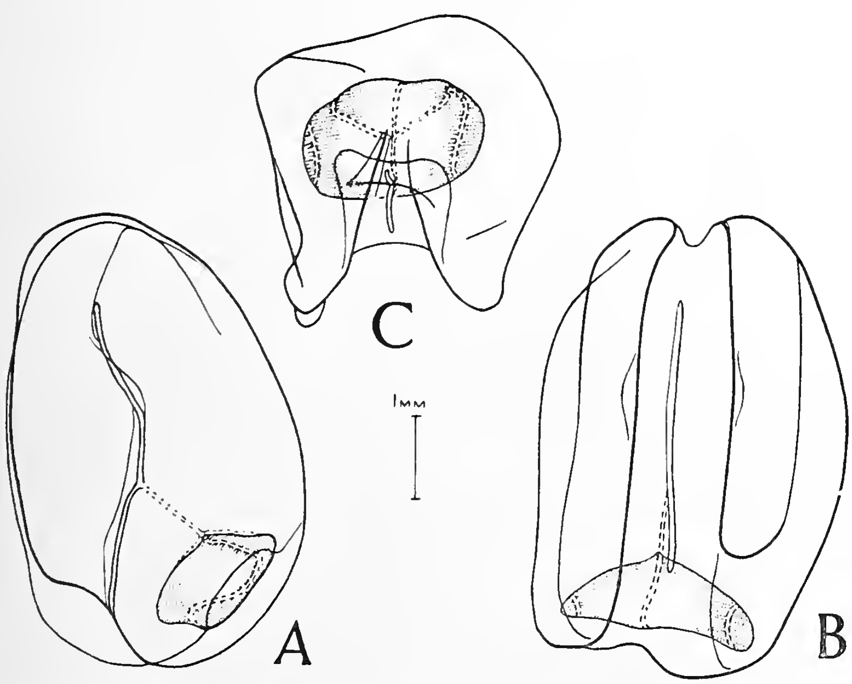
* Bigelow (1911*b*) said that throughout the 5-month cruise of the " Albatross " in the Eastern Tropical Pacific he had the opportunity of studying the siphonophores—one of the most extensive series ever collected—alive, but as far as I know he published nothing about their behaviour.

Prayidae.

There are ten recognizable and one doubtful species of Prayids which are to be assigned to six or seven genera. The only one that is at all common has for the last eighty-eight years been known as *Praya cymbiformis*, Delle Chiaje. Unfortunately strict adhesion to the rules of nomenclature results in the application of the name *Praya* (originally spelt "*Praia*") to the form for which Bigelow (1911) erected a new genus, *Nectodroma*.* Two other names are avilable for the genus of which *cymbiformis* is the genotype, namely, *Eudoxella*, Haeckel, 1888*a*, and *Huxleya*, Gravier, 1899. But I am inclined to believe it is congeneric with *Rosacea*, in which case that name would have priority.

Rosacea ? plicata, Quoy and Gaimard, 1827.

A single nectophore, probably the elder one, 5·6 mm. in length, taken in an oblique haul at St. 26 in Trinity Opening on 19th November, 1928.



TEXT-FIG. 10.—*Rosacea ? plicata*, Quoy and Gaimard. × 11. A, Lateral view of the nectophore to show the course of one of the radial canals; B, ventral view of same; C, apical view of same.

The specimen corresponds in general with a nectophore of *Praya diphyes*, Blainville, figured by Vogt (1854). In the absence of any very critical published morphological details of this species I make this tentative identification following Bigelow's synonymy. The left hydroecial fold is shorter than the other, whether as the result of an accident it is not possible to say. The nectosac is somewhat deformed—probably a post-mortem change—and it is not easy to see exactly how the curved lateral radial canals run.

* *Praia* was clearly applied by Blainville to a form with laterally branched somatocyst. He said " . . . j'ai pu très-bien apercevoir un vaisseau médian donnant deux branches latérales, avec des ramifications bien similaires." The application of the name "*Praya*" has been discussed by Bigelow (1931) since this was written.

Amphicaryon acaule, Chun, 1888.

A single complete specimen was taken at St. 50, outside Papuan Pass, on 18th March, in a vertical open net fished from 170 m. to surface. The smaller, shield-shaped nectophore, with its vestigial closed nectosac, measures 2·47 mm. in length, and the larger one 3·14 mm. The state of preservation is not very good, but is sufficient to enable me to identify it without doubt.

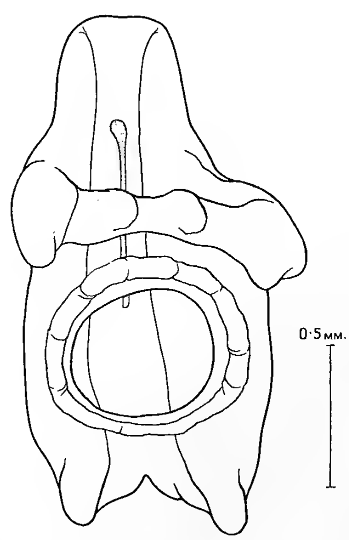
Bigelow held the vestigial nectophore to be the primary one, chiefly because in a specimen 3 mm. long this nectophore was longer than the other. Moser, however, described a still smaller specimen, 2·5 mm. in length, in which the lengths of the two nectophores were equal. I am inclined to agree with Moser that the vestigial nectophore is probably the secondary one.

The known distribution is as follows: W. Indies (Bigelow); Chesapeake Bay (Bigelow); Canaries (Chun), Tropical and Subtropical Atlantic (Moser); Chagos, Farquhar and Amirante Is., Indian Ocean (Browne); Eastern Tropical Pacific (Bigelow). It appears to be a midwater species, and thus to have escaped much attention.

Hippopodiidae.

(?) *Hippopodius hippopus* (Forskål, 1776).

The material consists of a single nectophore 4 mm. in length, a single larva or primary bell, 1·5 mm. long, and a female gonophore 1·9 mm. long. The nectophore is rounded, but not well enough preserved to show the dorsal prominences. The specimens were taken in a vertical haul from 400 m. to the surface outside Papuan Pass on 18th March, 1929.



TEXT-FIG. 11.—(?) *Hippopodius hippopus*. × 37. Dorsal view of a young nectophore.

Two small nectophores, 1·9 mm. and 3·6 mm. in length, from St. 50 outside Papuan Pass, 18th March, probably belong to this species. I have examined an even smaller nectophore removed from an undoubted specimen of *H. hippopus* taken in the Tropical Atlantic, and it agrees closely in shape with the one figured (Text-fig. 11); but the next

older nectophore of that same Atlantic specimen, although it is smaller than the second Barrier Reef one, has already assumed the characteristic shape found in older nectophores of *H. hippopus*.

These young Barrier Reef nectophores resemble Bigelow's figure (1918, pl. 4, figs. 2, 3) of a nectophore of *Vogtia glabra* 7 mm. long in their elongate outline and pointed apex, but have four dorsal prominences as in *H. hippopus* instead of two as in *V. glabra*. I have not seen any nectophores of *V. glabra* smaller than one 4 mm. in length, and that is already beginning to assume its definitive shape, and has only two prominences.

Abylidae.

(Abylinae, L. Agassiz, 1862.)

It might be argued that *Bassia* and *Abylopsis* are more primitive than *Abyla* and *Diphyabyla*. For in the posteror nectophore of both *Bassia* and *Abylopsis* there are lateral ridges, and in that of *Abylopsis* also a complete dorsal ridge, while the right and left hydroecial folds stretch across the hydroecium as in the Diphyidae. In *Abyla* and *Diphyabyla*, on the other hand, there is a general reduction of these ridges, and the hydroecial folds may be hypertrophied into very large parallel plates which no longer roof over the hydroecium. But *Bassia* and *Abylopsis* differ from all other Diphyids in the peculiar way in which the two nectophores are orientated and articulate with one another. They have, too, a peculiar arrangement of ridges of the anterior nectophores, which appears to be connected with the stream-lining of this new arrangement. It can therefore be argued, I think, that these genera are more specialized than *Abyla* and *Diphyabyla*. One way of reconciling these views is to suppose that in *Bassia* and *Abylopsis* the chief evolutionary changes have taken place in the anterior nectophore and its articulation with the posterior, while in *Abyla* and *Diphyabyla* it is in the posterior nectophore that these have occurred.

Indeed I have noticed, while observing living specimens of *Abylopsis tetragona* in the Gulf of Algeciras, that the two nectophores appear to function independently. Propulsion is effected by the rather slow rhythmic contraction of the posterior nectophore, while the anterior one appears to contract spasmodically, but more rapidly.

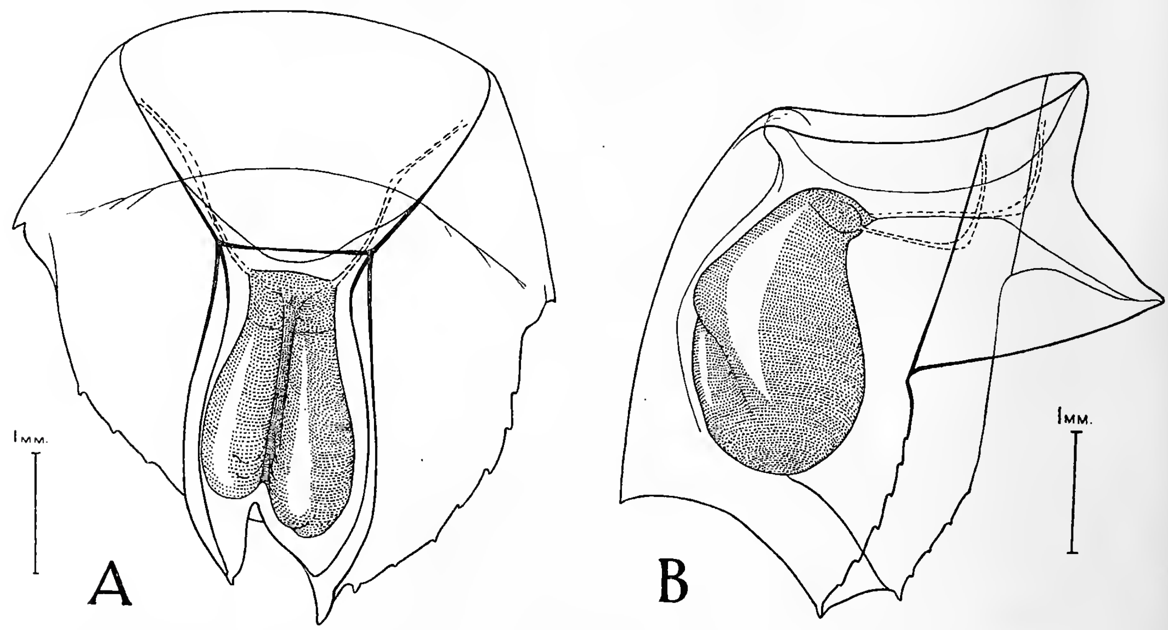
Abyla haeckeli, Lens and Van Riemsdijk, 1908.

One anterior nectophore, the identification of which rests upon the presence of a transverse ridge dividing the ventral facet into two parts, was taken at the weekly station 3 miles east of Low Isles on 2nd October. With it were taken two Abylid posterior nectophores, neither of which is in a good state of preservation. The characters of both were elucidated by manipulation with needles.

One of these posterior nectophores, which is 10 mm. in length, I believe to belong to this species. Its nectosac is relatively short in comparison with the pedicel. There is a large median dorsal tooth and corresponding ridge, a right lateral tooth and ridge, and a left lateral tooth without ridge. The left hydroecial ridge is not toothed, but appears to have a thickened edge (" Polster ") in the middle region, where both ridges are most prominent. The right hydroecial ridge has a proximal toothed flap and a distal toothed

edge. The five teeth in this basal region decrease in size from the middle region towards the velar end, the last being just above the level of the velum. There is no thickened mouth-plate with oblique basal facet, such as is found in *A. trigona.* Instead the plate connecting the two ventral teeth is quite thin.

I have assigned tentatively to this species two Abylid eudoxids that resemble the type (" *Amphiroa* ") usually assigned to *A. trigona.* In the past, Abyline eudoxids have been referred, if of the " *Ceratocymba* " type, either to *Ceratocymba sagittata* or *C. asymmetrica* ; if of the "*Amphiroa*" type, to *Abyla trigona* ; and if of the " *Cymba* " type, to *A. leuckartii.* But the eudoxids of *Abyla dentata* and *Diphyabyla hubrechti* are of the " *Ceratocymba* " type too. It is clear that much critical work remains to be done on the Abylid eudoxids. For instance, I am unable to find sufficiently critical descriptions and figures of eudoxids definitely known to belong to *A. trigona.*



TEXT-FIG. 12.—*Abyla haeckeli,* Lens and van Riemsdijk. × 16. The bract of a eudoxid. A, dorsal view, showing artefact ; B, lateral view.

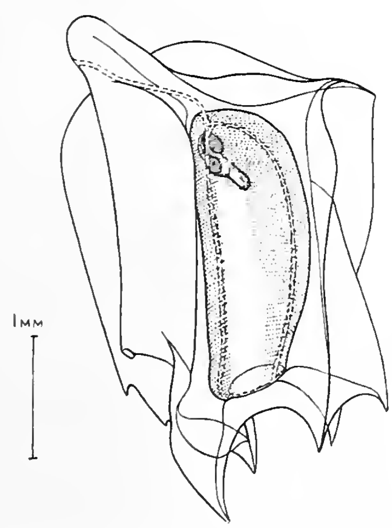
We know that *haeckeli* occurs in the Barrier Reef region. Now since its eudoxid is likely to resemble that of *A. trigona* because of the similarity of their anterior nectophores, and since eudoxids differing slightly from those found in association with *trigona* have been taken there, it is probable that these eudoxids can be assigned to *haeckeli.**

The outline of the bract, when viewed from the dorsal side, somewhat resembles that of *Ceratocymba,* the edges of the lateral walls of the hydroecium being bowed out and toothed. The ventral facet is convex. The arrangement of teeth on the hydroecial flap or " Leiste " of the gonophore differs from that figured by Lens and Van Riemsdijk for *A. trigona.* Bigelow, it will be remembered, maintains that the bract of the eudoxid of *haeckeli* has a concave ventral facet and an asymmetrical greatly developed " left " ventro-basal angle as in *Amphiroa dispar,* Bedot (1896).

* Since this was written, anterior nectophores of *A. haeckeli* and "*Amphiroa*" eudoxids have been found in association in hauls made in the New Zealand region by the British Antarctic (" Terra Nova ") Expedition, 1910–13.

One of these eudoxids, with gonophore attached and a single gonocalyx 6 mm. in length, was taken at an intermediate station inside Papuan Pass on 17th March. It is crushed, but the general shape of the phyllocyst with its large ovoid descending branch can be plainly seen. The loose gonocalyx (Text-fig. 13) has a small vermiform manubrium. There is a well-developed right ventral (hydroecial) ridge, toothed on its basal margin. A small delicate left hydroecial flap (Leiste) with a pronounced tooth is visible, but is crumpled slightly. The median dorsal and other four teeth are in a good state of preservation. Viewed from the side, the mouth-plate can be seen to have a flattened, oblique, basal facet, such as is found in the posterior nectophore of this and other species of *Abyla*. The attached gonophore is the mirror image of the loose one. Its manubrium is not visible.

The second, consisting of a well-preserved but slightly damaged bract and a well-preserved loose female gonophore, was taken the next day at St. 50, outside Papuan Pass.



TEXT-FIG. 13.—*Abyla haeckeli*, Lens and Van Riemsdijk. × 16. Lateral view of a gonophore, showing the incomplete dorsal ridge and tooth.

The flap or " Leiste " of the gonophore has one large basal recurved hook-like tooth, and a smaller vestigial one close to the ventral wall of the hydroecium. The base of the left ventral (hydroecial) ridge bears two strong teeth. The dorsal median ridge, which extends for only half the length of the dorsal facet, lies asymmetrically, nearer to the right dorsal ridge. The radial canals, which appear to be reticulated, do not run in the usual dorsal, ventral and lateral positions. The dorsal canal runs under the right lateral ridge, though it meets the circular canal under the median dorsal tooth. The right lateral runs inside the right ventral ridge, but the left lateral canal lies inside the left lateral ridge in its normal position, and the ventral canal lies inside the remaining left ventral ridge. The manubrium bears two ova.

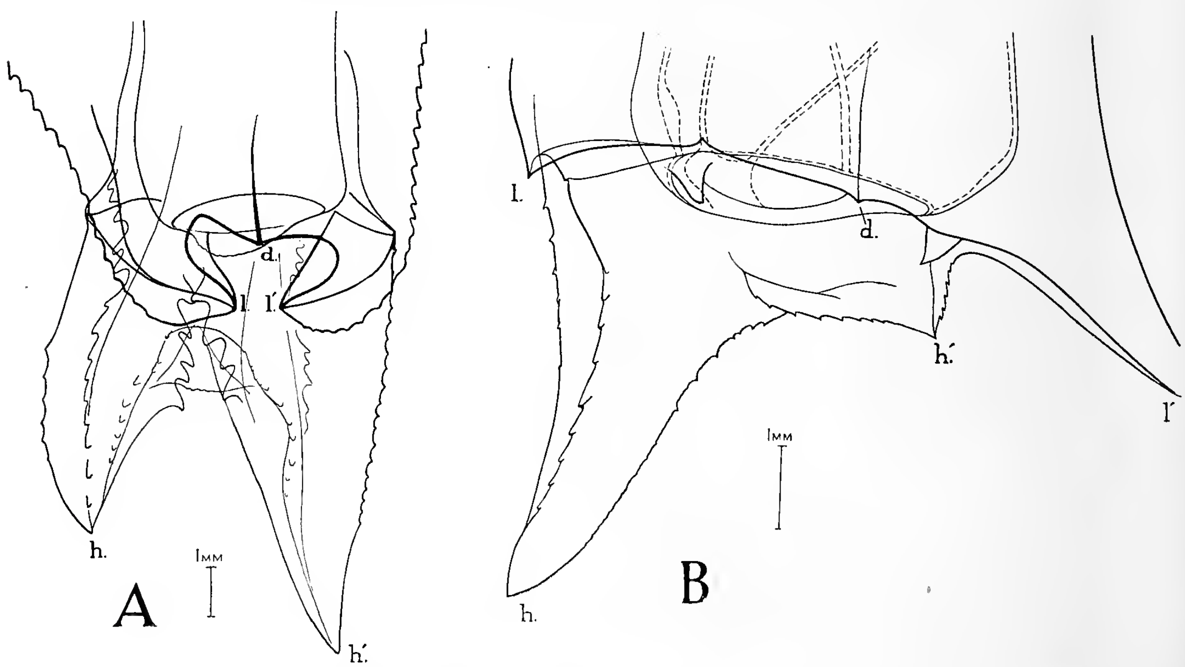
Abylopsis tetragona (Otto, 1823).

Specimens of the polygastric and eudoxid stages were taken in ones and twos in all months of the year except December, April, May and July at the weekly inside, three outside and one intermediate stations. The estimated total numbers taken are 15

polygastric specimens and 18 eudoxids—a remarkably small number for a year's tow-netting work.

Five specimens of the two stages were taken at the vertical distribution stations 16 and 62 in the upper layers (3–8 m.).

This species links the genera *Abyla* and *Abylopsis* together. The two peculiar oblique folds at the base of the mouth-plate (Text-fig. 14) can be homologized with the margins of a flattened elliptical area of the same structure in *Abyla dentata*, Bigelow (=*A. quadrata*, Moser) (Text-fig. 15). This rather trivial feature may be of some importance in considering questions of phylogeny, as it appears to be a vestigial character. The significance of the peculiar arrangement of radial canals is that it is a device for making a new arrangement



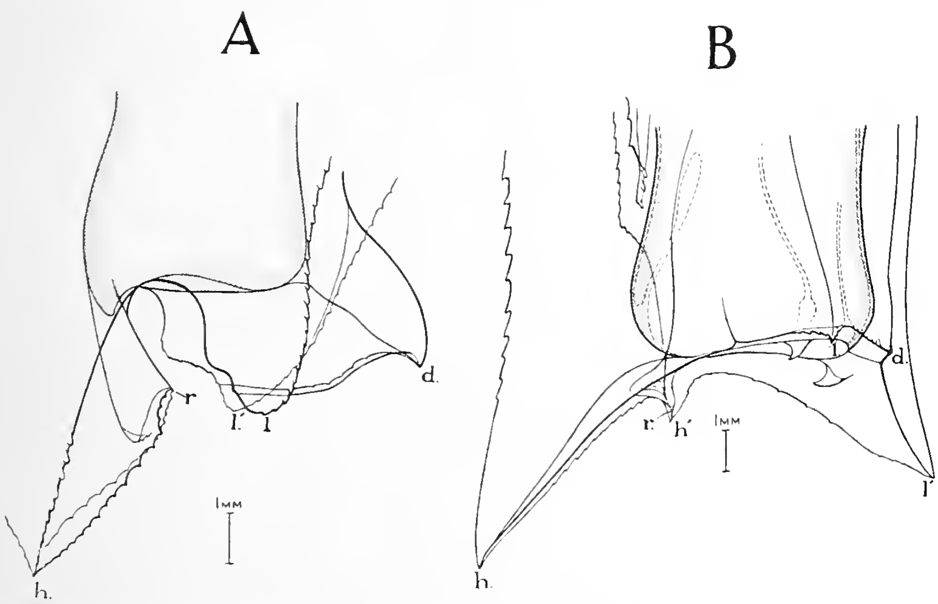
TEXT-FIG. 14.—A, *Abyla dentata*, Bigelow. × 6·5. Dorsal view of the base of the posterior nectophore; B, *Abylopsis tetragona* (Otto). × 11. Same view. *r*, The ridge at the base of the mouth-plate; *d*, dorso-basal tooth; *l*, latero-basal teeth; *h*, h^1, basal ends of the right and left hydroecial walls.

of five radial canals out of four, the new one lying under the right ventral ridge. The proximal part of this fifth canal is formed by the deflected and altered left lateral. There is then a gap, and the distal part is a new oblique offshoot from the ventral " Gefässplatte." In *A. dentata* this left ventral ridge is associated with a canal by a change in the course of the median dorsal, over which there is no longer a complete ridge, and the left lateral, the first taking the place of the second, which in its turn comes to lie inside the left ventral. It is this left ventral ridge that becomes displaced and finally reduced in *Abyla*, and the changes in the arrangement of the radial canals in Abylids appear to be correlated with this.

There are two small, pointed, prominent, basal projections (Text-fig. 15*b*) underlying the two lateral " Gefässplatten." They are referred to by Haeckel as " the distal prolongations of the two dorso-lateral edges," but appear to be independent formations connected with the close proximity of the " Gefässplatten."

I observed that numerous specimens taken alive in the Gulf of Algeciras in March, 1931, swam slowly by rhythmical contraction of the posterior nectophore. Like many salps that I observed at the same time they swam in open spiral courses, with the hydroecium of the posterior bell on the inner side of the spiral, and with stem contracted. It was only occasionally that the minute anterior bell pulsated, which it did with a rhythm more rapid than that of the posterior bell.

Bigelow (1931) has already referred to two criteria for separating the loose anterior nectophore from that of *A. eschscholtzii*. A third one I would mention is that in *A. tetragona*, the length of that part of the ventral wall of the nectosac that extends from the



TEXT-FIG. 15.—A, *Abyla dentata*, Bigelow. B, *Abylopsis tetragona* (Otto). × 6·5. Lateral views of the bases of the posterior nectophores to show the ridge, *r*, at the dorsal side of the flattened elliptical area of the mouth-plate. Lettering as in Fig. 14.

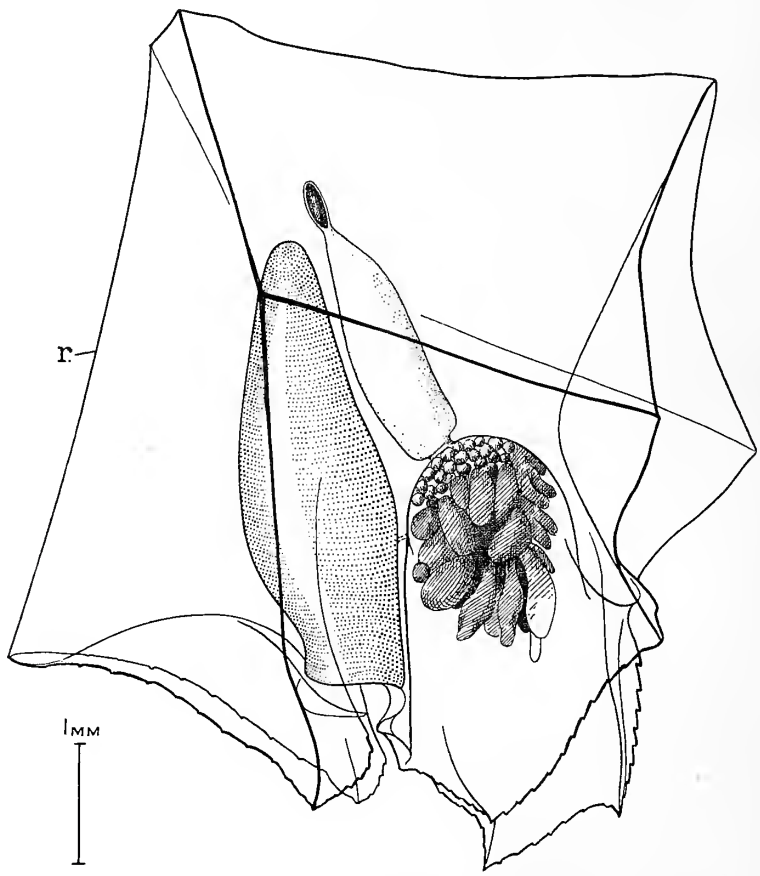
velum to the point where the pedicular canal joins the subumbral canal system is shorter than the other part between this junction and the apex of the nectosac. In *A. eschscholtzii* the reverse holds true.

Enneagonum hyalinum, Quoy and Gaimard, 1827 (=*Cuboides vitreus*, Quoy and Gaimard, 1827).

Specimens of both stages were taken regularly at the weekly station, two outside stations, and three intermediate stations from 4th January until 17th July. For the rest of the year no specimens were taken. The estimated total numbers taken are 36 polygastric and 286 eudoxids. Twenty-one specimens were taken at one "vertical distribution" station in daylight, a single polygastric specimen at the surface, 11 eudoxids at 8 m., 2 at 16·5 m., and 7 a little deeper still.

Huxley (1859) carefully homologized the facets of the polygastric nectophore which he called *Abyla vogtii* with those of *Abylopsis tetragona* and *Bassia bassensis*. The essential difference was, he said, that there is a median dorsal ridge instead of a pentagonal dorsal

facet (see Text-fig. 22). This homology appears to have been overlooked by some subsequent authors, especially Chun (1892), whose beautifully executed lithographs obscure this point completely. One is at first tempted to believe that this dorsal longitudinal ridge, which is found in the gonophore as well, is homologous with the dorsal ridge in *Diphyes*, and is a primitive feature ; but *Enneagonum* is the only Abylid known with such a ridge in the anterior nectophore, and it seems more probable that it is a secondary feature, perhaps introduced after the loss of the posterior nectophore to restore balance in some way.

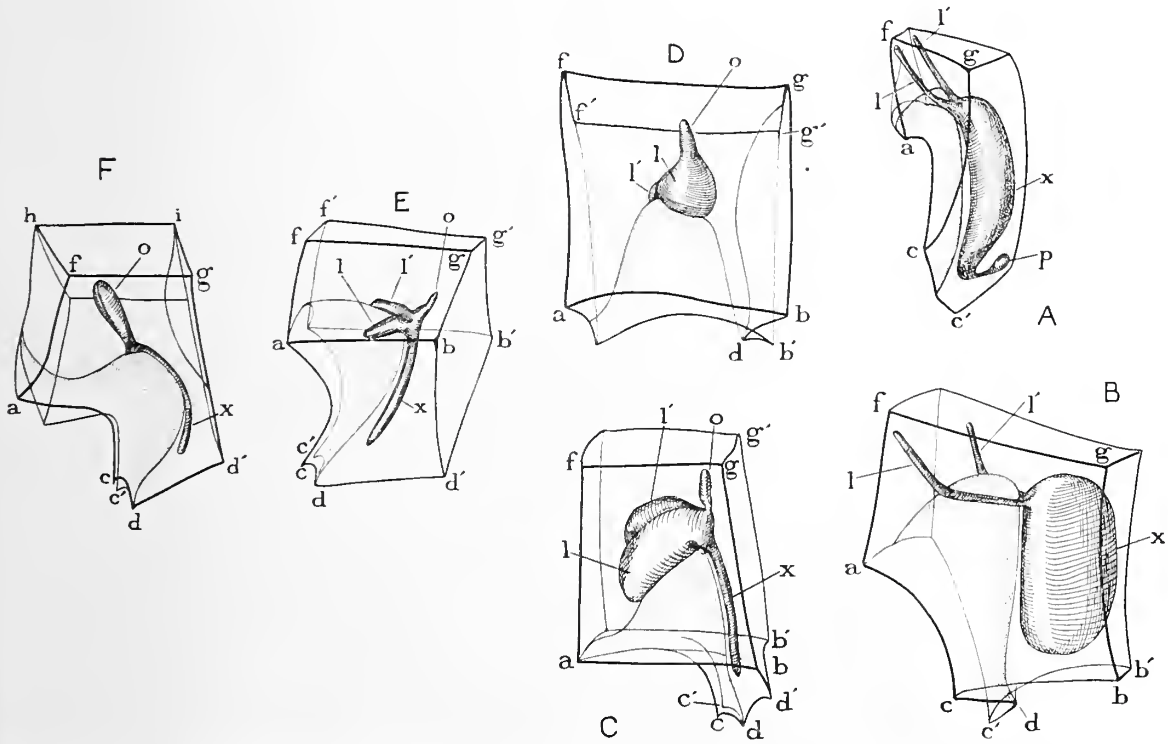


TEXT-FIG. 16.—*Enneagonum hyalinum*, Quoy and Gaimard. × 16. Lateral view of a nectophore to show its homologies with those of *Abylopsis tetragona* and *A. eschscholtzii*. *r*, The dorsal median ridge peculiar to this species. The appendages are shown diagrammatically.

I do not share the view of some authors that Quoy and Gaimard's *Enneagonum hyalinum* cannot be recognized, or that there is more than one species to which the description and figures could apply, and for this reason I am obliged reluctantly by the rules of nomenclature to reintroduce their name. The description and figures, which will fit no other species, together with the fact that the polygastric and eudoxid stages were found together, and the fact that the authors commented on a similarity in the behaviour of each when alive—all these points leave me without the slightest doubt about the identity of Quoy and Gaimard's species.

As to the meaning of Quoy and Gaimard's " seconde partie " which is enclosed in " la moyenne cavité," or hydroecium, I take it to be the gonophore of one of the eudoxids,

since it has five teeth and a lateral canal. The figures in Quoy and Gaimard's plate 2D can be recognized as follows: Fig. 1, lateral view from left side, showing the nine points, but not illustrating the full extent of the hydroecial walls; fig. 2, basal view looking into hydroecium; fig. 3, apical view (*cf.* Chun, 1892, pl. xi, fig. 2): fig. 4, lateral view (*cf.* Chun, fig. 4); fig. 5, young gonophore; fig. 6, nectosac and somatocyst with apical projection, and appendages. In fig. 1 the arrangement of the nine points is correct, although they could not be seen as illustrated from any one view-point. It should be noticed that in their explanation of the plate these naturalists state that the apical angle "se trouve toujours en dessous." This seems to imply that the live animals take up that position.



TEXT-FIG. 17.—Diagrams of the bracts of Abylid eudoxids. A, "*Cymba*" type (*Abyla leuckartii*); B, "*Amphiroa*" type (*Abyla trigona, A. haeckeli*); C, E, "*Aglaisma*" type (*Abylopsis tetragona, A. eschscholtzii*); D, "*Cuboides*" (*Enneagonum*); F "*Sphenoides*" (Bassia). The bracteal cavities have been dotted, and the phyllocysts hatched. The bracts are so orientated as to show their homologies. *a b*, Cross ridge; *a c d*, hooked baso-lateral wall of bracteal cavity; $d\ d^1$, baso-sagittal ridge; *h i*, apico-sagittal ridge; $c\ c^1\ b\ b^1$, square, basal facet; $b\ c$, $b^1\ c^1$, baso-lateral ridges.

It seems opportune to invite special attention to the Abylopsine relationship of *Enneagonum*; and some detailed morphological considêrations will make the understanding of it more easy.

The eudoxids of the Abylopsinae are of the "*Aglaisma*," "*Cuboides*" and "*Sphenoides*" types, and their study reveals their homologies with those of the *Abylinae*, which are of the more generalized "*Amphiroa*," "*Cymba*" and "*Ceratocymba*" types. The "*Aglaisma*" of *Abylopsis tetragona* may be regarded as the most generalized of the Abylopsine eudoxids; and the asymmetrical "*Cymba*" and "*Ceratocymba*" are perhaps

the most generalized of the Abyline eudoxids, because they have no cross ridges (Text-fig. 17 *a*, *b*), running from the baso-ventral rim of the bracteal cavity of the bract to its dorso-lateral ridges, and the dorsal facet is not divided by the ridge $b\,b^1$; most of their other ridges and facets can be homologized with those of the " *Aglaisma* " of *Abylopsis tetragona*. Development from this " *Aglaisma* " type seems to have led in two directions, firstly to the suppression of the hooked baso-lateral walls of the bracteal cavity and of the baso-sagittal ridge (Text-fig. 17, D, $d\,d^1$, " *Cuboides* "); and secondly to the enlargement of these same parts in *A. eschscholtzii*. The bract of *Bassia* ("*Sphenoides*") seems to be a retrograde development of the *eschscholtzii* type, in which the cross ridge $a\,b$ has been suppressed, and the paired (ventral) horns of the phyllocyst have been lost, whilst an apico-sagittal ridge (Text-fig. 17F, $h\,i$) has transformed the original rectangular facet $f\,g\,f^1\,g^1$ of the other types into a pair of apical facets, $f\,g\,h\,i$, $f^1\,g^1\,h\,i$.

The bracts of " *Aglaisma* " and " *Sphenoides* " differ from that of " *Amphiroa*," which has a square basal facet $c\,c^1\,b\,b^1$, in the possession of a new baso-sagittal ridge $d\,d^1$, the baso-lateral ridges $b\,c$, $b^1\,c^1$ being absent. In " *Cuboides* " the baso-sagittal ridge $d\,d^1$ has shortened to the vanishing point d. Even in *Abylopsis tetragona* (Text-fig. 17*c*) it is of variable length, being sometimes very much shorter than is shown in the figure.

The fact that the oily content of the phyllocyst collects in an apical horn in " *Aglaisma* " and in a dorso-basal horn in " *Cymba* " and " *Ceratocymba* " is probably due to differences in habit and posture.

The differences in shape of the phyllocyst in Diphyids and Abylids can generally be correlated with differences in the relative volumes of the parts of the bracts. In *D. bojani* it will be remembered that there is a very thin bract, and that no apical horn is developed at all. In *Bassia*, where the basal part of the bract is long and narrow, we find an elongated basal horn; so in " *Cuboides* " where the basal part of the bract has been suppressed, we find no basal horn at all.

Abylopsis eschscholtzii (Huxley, 1859).

About 70 specimens of the polygastric stage and upwards of 320 eudoxids are estimated to have been taken at the weekly station three miles East of Low Isles, at four outside stations, and intermediately during the greater part of the year. Between 4th January and 7th June they were taken only twice, on 17th March at an intermediate station, and on the next day at an outside one.

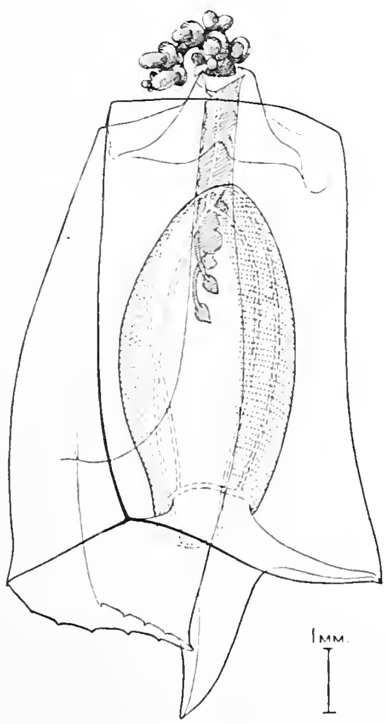
Forty-four specimens were taken at vertical distribution Station 16, the four polygastric specimens coming from between the surface and a depth of 8 metres. Sixteen more were taken at vertical distribution Station 68, the six polygastric specimens being taken at about the same depth.

Some of the bracts of the eudoxids are parasitized by young Hyperiid amphipods, which probably feed on the reserve food stored in the phyllocyst. Hyperiids were found also in *Sulculeolaria quadrivalvis*, apparently feeding on the musculature of the bell of the posterior nectophore, and also in *Enneagonum hyalinum*, close to the phyllocyst of the bract of the eudoxid. In *Lensia subtiloides* what may be similar amphipods were found close to the somatocyst of the nectophore.

Bassia bassensis (Quoy and Gaimard, 1833).

Specimens of both stages were taken in most of the catches made at inside, outside and intermediate stations throughout the year, except for a period of nearly three months between 17th March and 7th June. The numbers estimated to have been taken are about 80 in the polygastric stage, and 350 eudoxids. The material is not in very good condition, and includes only one complete polygastric specimen, which has a small, though unmistakable reserve nectophore bud.

I can see no trace of the almost obsolete ridge marked by a very small pointed prolongation of the distal wall of the hydroecium of the posterior nectophore figured and



TEXT-FIG. 18.—*Bassia bassensis* (Quoy and Gaimard). × 8·5. Dorsal view of posterior nectophore, showing how the posterior end of the right lateral ridge twists up on to the dorsal side, and the left hydroecial fold forms a ventral keel in the centre line.

mentioned by Huxley. It is neither figured nor mentioned by Haeckel. Bigelow (1911*b*) says that the "right" lateral ridge is entirely suppressed. In my judgment it is not one of the laterals which has been suppressed, but the median dorsal ridge. The after end of the posterior nectophore is twisted round slightly (Text-fig. 21), so that the posterior end of the right lateral is brought near the middle line. On the opposite side the left ventral ridge bounding the hydroecium forms a keel near the middle line. *Bassia* has no caecal prolongation of the somatocyst such as is found in *Abylopsis*, and the whole somatocyst seems to have been secondarily displaced to a forward position. There is in its ventral side a cleft-like compartment, apparently bounded within by a membrane, and running nearly the whole length of the somatocyst. At its distal end is usually found the oil globule. The somatocyst of most Siphonophora is divided longitudinally in a similar way. Some individual variation is observable in the branching of the radial canals.

The normal arrangement appears to be that figured by Bigelow (1911*b*), pl. 14, fig. 9, where the four canals make a single junction with the pedicular. In some nectophores the laterals join the dorsal midway between the junction of the pedicular and the blind apex of the sac, the right lateral effecting a junction proximally to the left.

Diphyidae. Eschscholtz, 1829.

Galeolarinae, Chun, 1897 + *Muggiinae,* Bigelow, 1911 (pars) + *Diphyinae,* Moser, 1925.

Galettinae, Stechow, 1921.

Galeolarinae, Chun, 1897.

Taxonomy.—There are still a number of questions to be settled before the species of the genus known for so long as *Galeolaria,* and characterized by looped lateral canals in the posterior nectophore, can be clearly delimited. A group of species included with them by Moser and others, *campanella, truncata, subtilis, subtiloides, multicristata* and *fowleri,* has been separated off (see p. 364) as a new genus *Lensia.* Its species have simple and not looped lateral canals in the posterior nectophore, and have affinities with the Diphyinae.

Available data lead to the tentative conclusion that there are at least six or seven species. Firstly there is a group of four—*biloba, australis* (these may prove to be one and the same), *chuni* and *turgida*—all without basal teeth on the anterior nectophore, some of them, if not all, passing through a young phase in which there are no cross lateral canals, and all possessing an undivided or slightly notched basal flap in the posterior nectophore. There remains a group of three, *monoica, quadrivalvis* and *quadridentata,* all with basal teeth in both the anterior and the posterior nectophores, but none of them, as far as known, passing through a young stage which lacks the cross laterals. Whether there are intermediates between *quadrivalvis* and *quadridentata* is uncertain.

Nomenclature.—If this delimitation of species can be definitely established, the two groups may be given definite subgeneric or generic rank, the latter group retaining the old name *Sulculeolaria,* and the former the name *Galetta* (=*Galeolaria*).

Genus *Sulculeolaria,* Blainville, 1830.

Genotype.—*Sulculeolaria quadrivalvis,* Blainville, 1834, Lesueur MS.

Synonymy: Sulculeolaria, Blainville, 1830, p. 126; Blainville, 1834, p. 138.
Galeolaria (pars), Quoy and Gaimard, 1833, p. 43; Chun, 1897, p. 16; Haeckel, 1888, p. 150; Lens and Van Riemsdijk, 1908, p. 56; Bigelow, 1911*b*, p. 233; 1918, p. 415; 1919, p. 336; Moser, 1925, p. 135; Browne, 1926, p. 66; Candeias, 1929, p. 270; non *Galeolaria,* Lamarck, 1818, p. 371; Vanhöffen, 1906, p. 15.
Epibulia, Chun, 1888, p. 765 (1157).
Galetta (pars), Stechow, 1921, p. 261; Bigelow, 1931, pp. 540, 549.

Sulculeolaria is a valid generic name, since its publication by Blainville in 1830 was accompanied by a sufficiently good description. But the three specific names cited by him at that time were not accompanied by indications, definitions or descriptions within the meaning of the rules,* since, according to the first opinion rendered by the International Commission on Zoological Nomenclature, one cannot accept the reference by

* See International Rules of Zoological Nomenclature reprinted in 'Proc. Biol. Soc. Washington,' XXXIX, 1926, p. 81.

Blainville to Lesueur's unpublished figures as an "indication" of the identity of such species. In 1834, however, Blainville's citation of the same three specific names was accompanied by a good figure of the posterior nectophore of the first of them under Lesueur's manuscript name *S. quadrivalvis*.* The species so designated *ipso facto*† became the genotype of the monotypic genus *Sulculeolaria*, Blainville, 1830. Bigelow (1911*b*) selected *Galeolaria australis*, Q. & G., as the genotype of *Galeolaria*, Blainville, 1830. Blainville's use in 1830 of *G. australis* is not accompanied by an "indication" save a reference to a figure at that time unpublished, so that *G. australis* must be assigned to Quoy and Gaimard, 1833. Quoy and Gaimard's figure shows no somatocyst, so that it cannot be identified with actual specimens of the species that Bigelow (1911*b*) calls *australis* rather than with those referred by Candeias (1929) to *turgida*, Gegenbauer. We shall assume that *australis*, Q. & G. included all toothless forms, and that the name is applicable to the residual species after the separation off of *turgida*, *chuni* and any other toothless species. *Galeolaria* was preoccupied by Lamarck in 1818 for a worm, and was displaced by *Galetta*, Stechow (1921). If *Galetta australis* (Q. & G.) is considered to be congeneric with *Sulculeolaria quadrivalvis*, Blainville, then *Galetta* becomes a synonym of *Sulculeolaria*, which has page preference over *Galeolaria*; but the toothed forms may be retained conveniently in a separate genus *Sulculeolaria*, genotype *S. quadrivalvis*, Blainville, 1834, and the untoothed forms in a genus *Galetta*, Stechow, 1921 (=*Galeolaria*, Blainville, 1830, *non Galeolaria*, Lamarck, 1818), genotype *G. australis*, Quoy and Gaimard, 1833.

Sulculeolaria quadrivalvis, Blainville, 1834.

Material.—Parts of twenty specimens coming both from inside the Barrier and the deep water outside, as well as intermediately. Of the 19 hauls in which the species occurred, 10 were made at the weekly station three miles East of Low Islands on 17th August, 11th and 20th September, 2nd October, 11th November, 27th December, and 7th June, and 1 inside Cook's Passage on 28th February; 3 at outside stations, namely outside Trinity opening on 20th October, outside Cook's Passage on 28th February, and outside Papuan Pass on 18th March; and 5 at intermediate stations in Trinity opening on 24th August, 6th September and 19th November.

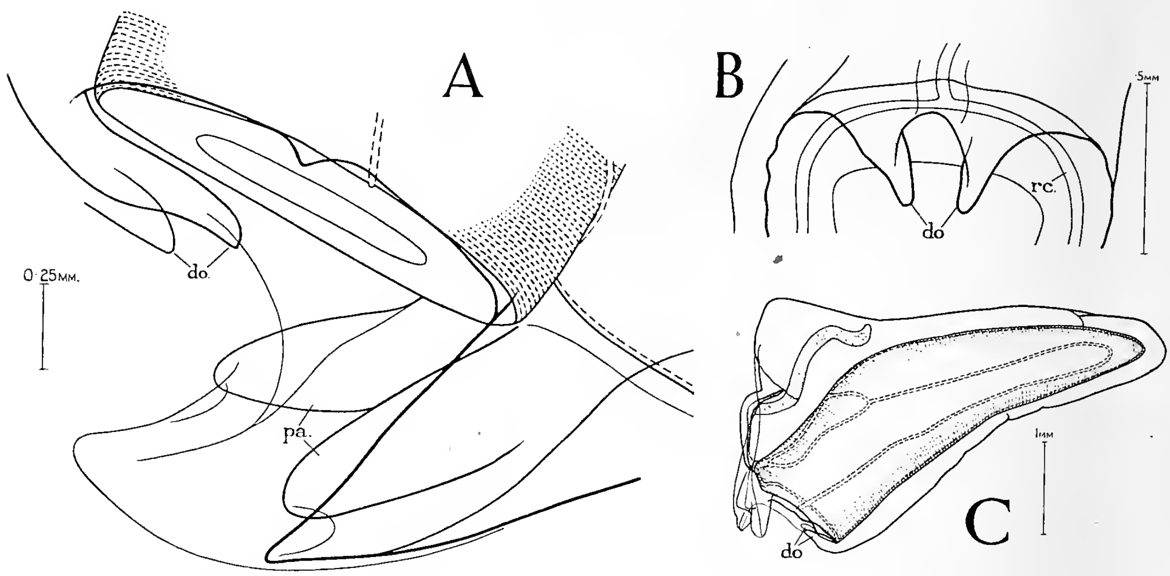
The 15 anterior and 15 posterior nectophores (except one, taken at 8 m. in a closing net at St. 16, three miles East of Low Isles at 11.15 a.m.) were all taken in vertical or oblique hauls of open nets. In ten cases there were associated a single anterior and posterior nectophore, which probably formed the two nectophores of a single specimen.

The criterion for identification of the anterior nectophores has been in each case the presence of the two characteristic "dorsal" teeth (Text-fig. 23, *do*). At present there is nothing known to distinguish the posterior nectophores of *S. quadrivalvis* and *S. quadridentata*, which Bigelow (1918) redescribed. I have examined specimens of the latter taken by the R.R.S. "Discovery" off Cape Verde and at other Atlantic stations, and others taken by myself off Kingstown, St. Vincent, B.W.I.

* Although Blainville's figure might represent the posterior nectophore of either *quadrivalvis* or *quadridentata*, yet the name *quadrivalvis* must be retained for the residual species after *quadridentata* and any others have been separated off.

† See Opinion 46 rendered by the International Commission on Zoological Nomenclature, reprinted in 'Proc. Biol. Soc. Washington,' XXXIX, p. 96.

Four of the fifteen specimens have small lateral teeth comparable with that figured by Bigelow (1931, fig. 197), one has teeth slightly longer and narrower, two have very slight eminences, and the rest have no lateral teeth at all. In one specimen, where lateral teeth were absent, the two dorsals were abnormally short.



TEXT-FIG. 19.—*Sulculeolaria quadrivalvis*, Blainville. A, Base of anterior nectophore, × 45, to show the oval vertical pads, *p a*, on the inner sides of the two lamellae of the mouth-plate; B, oral view of the nectosac, × 45, to show the two dorsal teeth, *d o*, and the ring canal, *r c*, in the velum; C, lateral view of anterior nectophore, × 12, in the position for horizontal progression.

Sulculeolaria monoica (Chun, 1888).

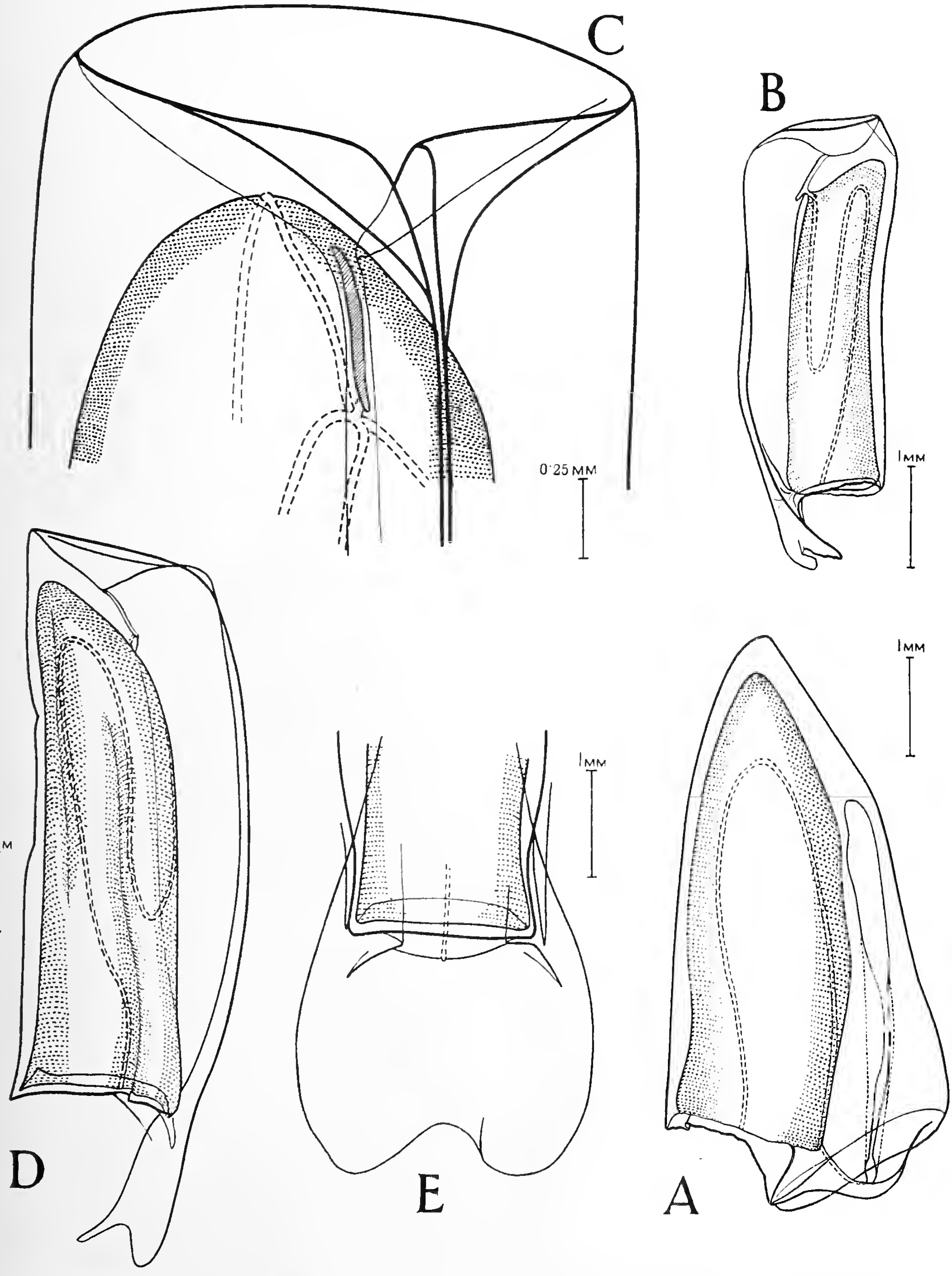
A single, crushed, anterior nectophore 8·5 mm. in length was taken at St. 16 in a closing silk tow-net, at a depth of 3·1 metres on 3rd October.

The characteristic narrow dorso-basal and two narrow latero-basal teeth, two small lateral flaps, two large ventro-basal wings with projections on their inner edges, and small somatocyst are sufficient for assigning the specimen to this species. I have recently seen a similar nectophore from the Atlantic which has very broad latero-basal teeth, and it is probable that two species will have to be recognized.

Galetta chuni (Lens and Van Riemsdijk, 1908).

The chief character by which Lens and Van Riemsdijk (1908) differentiated this species was the absence of lateral commissures between the dorsal and lateral radial canals. Browne (1926) maintained that the chief difference between *G. chuni* and *G. australis* was the longer somatocyst in *chuni*, the younger nectophores of which had at first no lateral commissures, but acquired them in the later stages of development.

I now have to record from the Great Barrier Reef 22 anterior nectophores without marginal teeth in which the lateral commissures are certainly absent. With these anterior nectophores were associated a number of loose posterior nectophores of the *Galetta* type; that is, with folded lateral canals, which appear to be of at least three types, none of them corresponding with those of *quadrivalvis*, *quadridentata*, *monoica* or



TEXT-FIG. 20.—*Galetta chuni* (Lens and Van Riemsdijk). A, Anterior nectophore, × 15·5, showing the small extent of the hydroecial cavity, the short mouth-plate and the long somatocyst, the basal part of which is unnaturally shrunken (a more normal outline is indicated in broken line); B, posterior nectophore with damaged apex, × 16, showing the folded lateral radial canal and notched lamella or ventral wing; C, ventro-lateral view, × 50, of the apex of the posterior nectophore of a specimen taken by the "Terra Nova" Expedition, 1910–13, at 6° 10′ N., 24° 5′ W. (scale = 0·25 mm.); D, lateral view, × 12·5, of the same; E, dorsal view, × 17, of the mouth-plate or ventral wing of the last specimen.

biloba. One specimen has a long rounded lamella which is devoid of an emargination. All of those others which are in reasonably good condition have a notched lamella (Text-fig. 20), one side of which is usually rather longer than the other. In one or two the notch is deeper than in the majority, in which it is shallow. A much larger series of 34 anterior and 35 posterior nectophores brought back from the Atlantic by the "Terra Nova" 1910–13 Expedition enables me to describe the posterior nectophores of *G. chuni* as having a notched lamella. Besides 15 anterior nectophores in which the somatocyst is relatively long (Text-fig. 20*b*), there are 7 in which it is very short. It soon became apparent that a short somatocyst and absence of cross-lateral canals could be correlated with two other characters, namely, a larger mouth-plate and hydroecial cavity, and a relatively greater distance between the apex of the nectosac and the apex of the nectophore, and a different origin of the lateral canals. I have had to abandon the laborious search for more specimens in the tow-nettings with which to test this difference, but that this second series belongs to a different species is borne out by the existence of a series of seven similar specimens I took off Kingstown, St. Vincent, B.W.I., in February, 1931. If such a correlation can be definitely established, it will mean the existence of a second species, related to *G. chuni* in having no cross-lateral canals in the early stages. Gegenbaur's name *turgida* may be used for it, since there is only a very small somatocyst, which we may suppose Gegenbaur overlooked.

Specimens of a *Galetta* with neither marginal teeth nor lateral commissures have now been recorded of lengths between 1·23 mm. and 12 mm. Browne (1926) held that because some specimens of *Galeolaria biloba* in the length group 5–7 mm. have commissures and others have not, whilst from the 15–20 mm. group specimens without commissures are absent, the specimens without commissures are early growth stages of the larger forms

Measurements of Anterior Nectophores of Galetta chuni.

[Unit of measurement = 1 millimetre.]

Station.	Nectophore.		Somatocyst.		Mouth-plate. Length.	Distance between forward end of nectophore and apex of nectosac.
	Length.	Depth.	Length.	Diam.		
20, c.	1·23	0·26	1·06	0·26	0·15	0·17
50, c.	2·2	1·1	1·14*	..	0·24	0·24
20, c.	2·4	1·2	1·1	0·15	0·15	0·15
50, s. 170 m.	3·8	1·9	2·6	..	0·38	0·23
19, 1 m.–c.	3·9	1·8	2·6	..	0·27	0·26
50, s. 400 m.	4·8	2·4	3·0	..	0·47	0·33
50, s. 170 m.	4·9	2·4	2·66	0·38	0·47	0·38
19, 1 m.–c.	4·9	2·4	2·0	..	0·54	0·18
50, s. 400	5·0	2·7	2·9	..	0·47	0·27
50, s. 170 m.	5·3	2·2	2·66	..	0·66	0·33
20, c.	5·4	2·6	2·4*	0·13	0·47	0·19
26, c.	5·8	2·8	3·9	..	0·66	0·3
50, s. 400 m.	5·9	3·0	3·8	..	0·66	0·33
13, s.	5·9	3·1	4·0	..	0·54	0·27
50, s. 400 m.	6·2	3·0	4·0	..	0·66	0·3

An asterisk (*) denotes that the somatocyst is curved, and was measured along the chord.

with commissures. If this can be definitely confirmed for a single species, it will be a point of some importance. The smallest of the three anterior nectophores without marginal teeth. but with lateral commissures and a long somatocyst (adult *G. chuni*) taken by the Expedition measured 5·5 mm. by 3 mm., and the smaller of the two with lateral commissures and a short somatocyst (adult *G. turgida*) 5·1 mm. by 2 mm. The largest specimens measured respectively 9 mm. by 4·5 mm.. and 9·5 mm. by 4·8 mm.

MEASUREMENTS.—Fifteen specimens of *G. chuni* were measured. Their lengths are from 1·23 mm. to 6·2 mm. There is a corresponding range in the length of the somatocyst of from 1·06 mm. to 4 mm. The depth of the anterior nectophore is half of its length, and the length of the mouth-plate about one-tenth.

Galetta turgida (Gegenbaur, 1854).

Six specimens: all except one, which was taken inside on 20th September, from three outside stations in March and October.

Though none are in a good state of preservation, it will be of interest to record the presence of these anterior nectophores characterized by the absence of teeth, very small somatocysts, and lamellae and hydroecial cavities relatively larger than in *G. chuni*. The critical definition of the species must be deferred until a more abundant material is available.

That such a species is to be distinguished from *G. australis* is made probable by the record of Candeias (1929), and by the capture I made recently of seven young specimens off St. Vincent, B.W.I.

As Bigelow has already suggested (1931), Gegenbaur's name seems to be both applicable and available.

DIPHYINAE, Moser, 1925.

With the exception of *Diphyes arctica* and *D. antarctica*, all the species generally assigned to *Diphyes* and *Diphyopsis* may be classified in three natural groups which can conveniently be given generic rank. When it is remembered that the total number of species of Siphonophora is only about 120, it is not surprising to find that these genera contain only two or three species each. Some difference of opinion has existed in the past on the question of whether the presence of a special swimming-bell in the eudoxid is sufficient warrant for separating certain species as a genus *Diphyopsis*. The three species in question are *D. dispar*, which is the genotype of the monotypic genus *Diphyopsis* (Haeckel, 1888), *D. bojani* (Chun), and *D. chamissonis*, Huxley. In view of the peculiarity of their eudoxids, the possession by the polygastric stages of these three of certain characters which are not found in other Diphyinae fully justifies the recognition of the genus *Diphyopsis*. The anterior nectophores of all three possess well-marked oral teeth, an undivided mouth-plate, and a deep hydroecium. The posterior nectophores of the first two are strikingly similar in every detail and quite unlike those of other species. *D. chamissonis* has evidently lost its posterior nectophore, and for that reason may be regarded as less closely related to *dispar* and *bojani* than each is to the other. It seems, however, hardly worth while to create two separate subgenera. A loss or reduction of the posterior nectophore is found elsewhere, for instance in *Enneagonum*, and is a phenomenon that apparently has taken place independently in more than one group.

Secondly we have a small group of two species closely related to each other, but less so to the rest—*D. spiralis*, Bigelow, 1911, and *D. mitra*, Huxley, 1859. Here again consideration of the sum of the characters of the eudoxid and polygastric stages justifies the separation of the two species as a new genus with genotype *D. mitra*, Huxley. The peculiar lancet-shaped wings of the mouth-plate, the shallow hydroecium with truncated apex and the peculiarly shaped eudoxid bract and elongated gonophores are characters that mark species of this genus.

Thirdly there is a group of two species, *D. appendiculata* and *D. contorta*, which resemble each other more closely than the members of other groups in the shapes of the anterior and posterior nectophores,* the mouth-plate, and the hydroecial cavity of the anterior nectophore. Free eudoxids of *D. contorta* have not been described, and it is open to doubt whether *Eudoxia campanula*, Leuckart, which is ascribed to *D. appendiculata*, or any other known eudoxid, is really the eudoxid of that species.

Left over for consideration are two interesting species—*D. arctica*, of which there was taken a single eudoxid, and *D. antarctica*, with which, though not represented in this collection, I am familiar. It may be regarded as a primitive representative of the first group.

Proceeding now to a discussion of the proper names of the genera of Diphyinae here defined, the first genus is found to contain a species, *D. dispar*, that is at the same time the genotype of Cuvier s *Diphyes*, 1817, and of Haeckel's *Diphyopsis*, 1888. The latter, therefore, must give way to *Diphyes*, Cuvier.

The first available name for the second genus is *Eudoxoides*, Huxley, 1859. This name Huxley used for the bract of the eudoxid of what we now know to be *D. mitra*.

The only available old names for the third genus are *Eudoxia* and *Cucullus*. Both, however, were originally applied to the eudoxids of *D. dispar*, and therefore are synonyms of *Diphyes*, Cuvier. In consequence there is no course open but to give, as I now do, a new name, *Chelophyes*,† to this new genus, which has for its genotype *D. appendiculata*, Eschscholtz.

Diphyes, Cuvier, 1817.

Diphyopsis, Haeckel, 1888.

Diphyes dispar, Chamisso and Eysenhardt, 1821.

Specimens of polygastric and eudoxid stages were taken at both inside and outside stations, as well as intermediately, from early September, 1928, to the end of the following March.

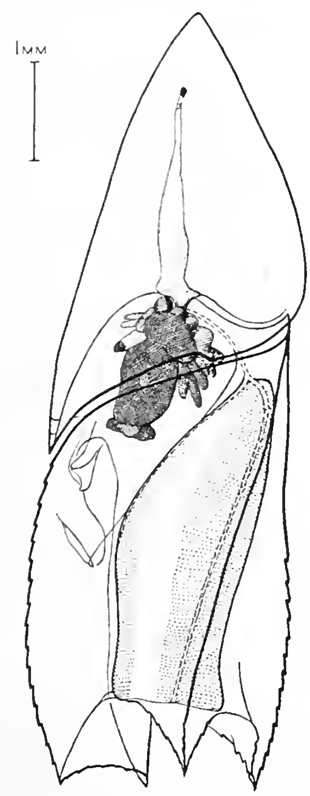
The eudoxid (Text-fig. 21) has hitherto been known as *E. lessoni*, but the only reasons for identifying it with Eschscholtz's *Eudoxia lessonii* are that he figures what may be taken as a long pedicular canal, and a nectosac which is curved in a manner that somewhat recalls that of *D. dispar*. At the same time it is difficult to see why he should have drawn the bract and the mouth of the special swimming-bell of *D. dispar* in the way represented in his figure.

* The posterior nectophore of *E. mitra* bears some resemblance to those of *Chelophyes appendiculata* and *C. contorta*.

† The allusion is to the claw-shaped outline of the hydroecium as seen in a lateral view.

It might be argued that the figure of *E. lessonii* is more like the endoxid of *Heteropyramis maculata*, especially as Eschscholtz says that the bract is "an dem freien Ende spitz." However, the "Schwimmhölenstuck" is too long and the nectosac too wide for *H. maculata*, although the mouth of the figured specimen of *E. lessonii* is characteristic. Again, should the inferior canal of the somatocyst in Eschscholtz's figure be really a bracteal canal and not the canal in the peduncle of a special swimming bell or gonophore, the identification with *D. arctica* would have to be considered, although it seems very unlikely.

The identification with Quoy and Gaimard's *Diphyes cucullus* seems to have very little foundation. Huxley's (1859) *Eudoxia lessonii* is certainly *D. dispar*, although he



TEXT-FIG. 21.—*Diphyes dispar*, Chamisso and Eysenhardt. × 13. Lateral view of the eudoxid.

could not distinguish between it and Leuckart's *E. campanula*, which has no special swimming bell, and a rounded mouth-plate to the gonophore, besides being much smaller.

Eschscholtz's *Ersaea gaimardi* may possibly be this species. The shape of the special swimming-bell and its mouth resemble *D. dispar*. Huxley regarded *E. quoyi*, Eschscholtz, in addition to *E. gaimardi* as a synonym of his *E. lessonii*, but the figures of the special swimming-bell of that ersaeid make this very improbable.

Huxley's figure of *Eudoxia lessonii*, which is the earliest recognizable one of the eudoxid of *D. dispar*, omits details of the apex of the special swimming-bell and radial canals, although he mentions that these branch off a little below the apex of the nectosac. In the figures of Fewkes (1881) and of Agassiz and Mayer (1902, fig. 41) the canals are represented as meeting at the apex. In their fig. 40 the canals do not meet at the apex. The apex of the nectosac and the arrangement of the canals are sound criteria, and

are not subject to much variation. Haeckel's (1888) figure is poor, and Lens and Van Riemsdijk's (1908) not good.

The most satisfactory figure of the eudoxid is that of Mayer (1900, fig. 96), although it does not show mature gonophores.

Now I will give a detailed description of the bract, special swimming-bell and gonophore.

The " sutural " surface of the bract of the eudoxid makes an acute angle with the dorsal side. The oral end of the sutural surface extends slightly beyond the level of the apex of the bracteal cavity. There are two teeth on the margin of the bract of the eudoxid, one lying just over the left ventral ridge of the swimming-bell, and the other just over the hydroecium, and projecting further in the oral direction. I took one eudoxid of this species off St. Vincent, B.W.I., in which the hydroecial fold and tooth were on the right side instead of on the left, which is the normal condition. The subumbrella of the special swimming-bell, which is closely coupled to the bract, does not extend very far into the saddle-shaped aboral part of the bell. The apex of the nectosac does not quite reach the level of the junction of the radial canals. The distance from its blind end to the canal-junction is relatively short. The terminal oral end of the nectosac is cylindrical and relatively long, the hydroecium not extending much below its middle region. The dorsal teeth are relatively long and wide apart. The pedicular canal is very long and the hydroecium is correspondingly deep. On the right side of the dorsal end of the " saddle " is a projection or tooth, rather similar to that found in the hydroecium. The special swimming-bell (text-fig. 31) figured by Moser (1925, p. 191) is so unlike any that I have studied, and indeed so unlike that drawn in her sketch (pl. viii, fig. 2) of the whole eudoxid, that I think it may have been included by mistake in her description of the species.

The gonophore shown in her text-fig. 32 is distinctly recognizable, but does not clearly indicate the run of the ridges. What is described and figured as " ein kleiner spitzer Ausläufer " appears to be a short transverse ridge, sometimes only visible in its middle region as a small projection, that runs across the dorsal surface rather above the level of the apex of the nectosac from the upper part of the right* dorsal ridge to the upper part of the left ventral, and limits the oral end of the peduncle, which is very much flattened dorso-ventrally. The left dorsal ridge is incomplete above and does not reach this transverse ridge. The four radial canals lie under the ridges, and the oral ends of the two ventrals curve in towards one another. The dorsal teeth are broad and lie close to one another. Moser's gonophore is considerably more twisted than any I have seen. The apophysis or peduncle is very much flattened obliquely on the left side, where it is pressed against the bract as described by Moser. The left ventral ridge which forms one side of the hydroecium extends up on to the projecting ventral edge of the flattened peduncle, and curves round to the right to meet the apex of the peduncle. The right ventral ridge on the other side of the hydroecium is twisted above towards the dorsal side, and curves round to the apex of the peduncle, so that the upper part of the hydroecium is wide, shallow and twisted. The left and right ventral ridges meet above, and then join the left dorsal ridge on the ventral edge of the flattened apophysis. Younger gonophores fit into the hydroecial cavity of the older ones. All the gonophores borne by any individual eudoxid appear to be of one sex.

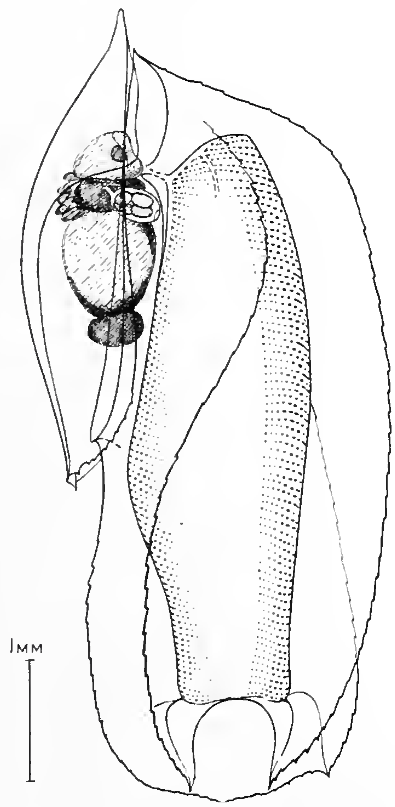
* The gonophores are of two kinds, the mirror-images of one another, so that the terms "left" and "right" may have to be reversed.

Diphyes bojani (Eschscholtz, 1825).

Polygastric and eudoxid stages were taken at inside and outside stations, as well as intermediately from the latter part of August to the middle of March.

The variations in the shape of the nectophores of the polygastric stage have been dealt with by Bigelow (1911*b*); and their study led him to a settlement of the synonymy.

The eudoxid (Text-fig. 22) appears at first sight very unlike other Diphyid eudoxids because of the shield-like bract. A further comparison shows that it is essentially similar, except that the semi-annular phyllocyst of the young bract never develops a secondary upstanding portion. The bract remains thin, the "sutural" surface being roughly



TEXT-FIG. 22.—*Diphyes bojani* (Eschscholtz). × 16. Lateral view of the eudoxid, to show the thin, shield-shaped bract.

parallel with the dorsal side as in the developmental stages of the eudoxids of *D. dispar* and *D. chamissonis*. Only a very shallow bracteal cavity is developed. The "saddle" of the special swimming-bell* or surface that articulates with the sutural surface is nearly vertical, instead of horizontal as it is in *D. dispar*. The ends of the phyllocyst grow out horizontally into horns, neither of which appears to be strictly homologous with the upstanding somatocyst of *D. dispar*. The bract is, in fact, one of the most primitive.

The mature gonophore has a cylindrical peduncle which is set on at an angle towards its right ventral side. No ridges are visible, but there are small vestiges of dorsal teeth, and a small elliptical mouth-plate can generally be seen. There are four straight radial canals, and the manubrium, which carries six or seven eggs in the female, nearly fills

* Bigelow (1911*b*) agrees with Lens and van Riemsdijk in denying the presence of a special nectophore.

the umbrella cavity. The right dorsal and left ventral ridges of the special swimming-bell lie in a plane which cuts the flattened bract at right angles, while the other two ridges lie in a plane parallel with that of the bract. The radial canals do not meet in a point, as noted by Chun (1892) and Moser (1925); the junction of the dorsal canals is at some little distance from the origin of the right ventral canal, and this again is slightly separated from the origin of the left ventral, the upper part of which is curved parallel to the margin of the hydroecium. The nectocalyx is asymmetrical, having an enlargement in the middle of the left side.

Eschscholtz's (1825) fig. 15, pl. 5, and (1829) fig. i, pl. 12, undoubtedly represent a specimen of this species, and serve as a useful criterion as to the accuracy of his figures, for the bract is drawn much too small, the spiral twist of the swimming-bell is not indicated, and the large undivided mouth-plate is shown divided. With the aid of binocular microscopes to-day, it is of course possible to examine and draw such complex structures more easily.

Huxley (1859) gave a good figure of the phyllocyst, feeding polyp and male gonophore *in sitû*, but his fig. 7 of the complete eudoxid gives an erroneous idea of it. The bract is shown as being set on to the bell at a curious angle, the large right dorsal ridge, which would be visible in the position shown, is not indicated, and the undivided mouth-plate, which would be visible "*en face*," is shown as divided.

Chun (1892) gave some lithographed figures of the whole eudoxid and of details, but whilst the artistic technique is admirable, the details are mostly inaccurate. In the figures of the whole eudoxid on his plate viii, the asymmetrical shape of the nectosac is not shown. In his fig. 4 the mouth of the swimming-bell is shown as not twisted far enough round relatively to the bract, although his fig. 5 shows the normal condition.

If Mayer's (1900) fig. 118 represents this eudoxid the bract is badly drawn, and what appears to be a male gonophore is labelled female. I have never seen male and female gonophores present in one and the same eudoxid. The drawing of the apex of the nectosac and the origin of the canals does not represent the usual condition. The apex of the sac extends up to the level of the phyllocyst and beyond the junction of the pedicular canal. His fig. 100 of *Diphyopsis hispaniana* will not convince anyone who is familiar with the eudoxid of *D. bojani*, but it probably represents this species; and the same criticisms apply to this figure that I have just made upon Chun's figure of *Ersaea picta*. The mouth-plate is drawn as divided—almost certainly in error. Bigelow (1911*b*) has given good figures. The homology of the bract with those of other eudoxids would have been made more clear by indicating the extent of the bracteal cavity. When the eudoxid is viewed so that the bract is seen in profile, as in his fig. 7, the twist of the bell is such as to bring the centre of the dorsal edge of the mouth more nearly in line with the centre of the mouth-plate. The drawing of the apex of the sac and the run of the canals does not show the normal state of affairs. The concavity of the nectosac in the region of the hydroecium is not indicated. When the eudoxid is viewed from the dorsal side of the bract, as in his fig. 8, the left edge of the mouth-plate would hardly cover the right dorsal tooth, and the diverticulum of the left side of the nectosac would be visible. The bract is often proportionately wider than the one figured by Bigelow.

Retia mirabilia are to be found at the velar ends of all four subumbral canals of the anterior nectophore, as in the related species *D. dispar* and *D. chamissonis*. The whole length of the ventral canal forms such a "Gefässplatte."

Diphyes chamissonis, Huxley, 1859.

With the exception of *Lensia subtiloides* this was the most abundant species inside the Barrier, and was taken both in the eudoxid and polygastric stages throughout the year. It occurred at three of the six outside stations in very small numbers, and was present at all the seven intermediate stations in some quantities, but never in such great abundance as that in which it appeared at the inside stations, three miles East of Low Isles.

This species, perhaps one of the lesser known Diphyids, was found originally in numbers during the voyage of H.M.S. "Rattlesnake" in the ship channel within the Barrier and in the Louisiade Archipelago (Huxley, 1859). Subsequent records are: Seychelles (Moser, 1925): Islands between Seychelles, Mauritius and Chagos (Browne, 1926); Maldives (Browne, 1904): Okhamandel Coast, W. India (Browne, 1926); Sumatra (Moser, 1925); Islands of Malay Archipelago (Lens and v. Riemsdijk, 1908); New Guinea (Moser, 1925; Lens and v. Riemsdijk, 1908); Sulu Archipelago (Lens and v. Riemsdijk, 1908); Phillippine Islands (Bigelow, 1919), and Japan (Moser, 1925). An additional record not hitherto published is off Noumea, New Caledonia, where numerous specimens of polygastric and eudoxid stages were taken on 8th and 9th August, 1895, at the surface in daylight, in water of a temperature of 71° F., by H.M.S. "Katoomba," Capt. J. E. Merryon, R.N. Four hundred and sixty eudoxids were taken in one of the surface hauls at 5 p.m.

Lens and Van Riemsdijk (1908) stated that in many specimens of their *D. weberi*, which is a synonym, they found a well-developed bud for the future inferior nectophore. Moser (1925) recorded that she could see no sign of either bud or posterior nectophore in the "Gauss" or "Siboga" material of this species. However, Browne (1926) said of this bud in his "Sealark" specimens, "I am able to confirm its presence." In the absence of further description or figure it was hoped that it might be possible to confirm this statement, but none of Browne's specimens showing the bud can now be found.

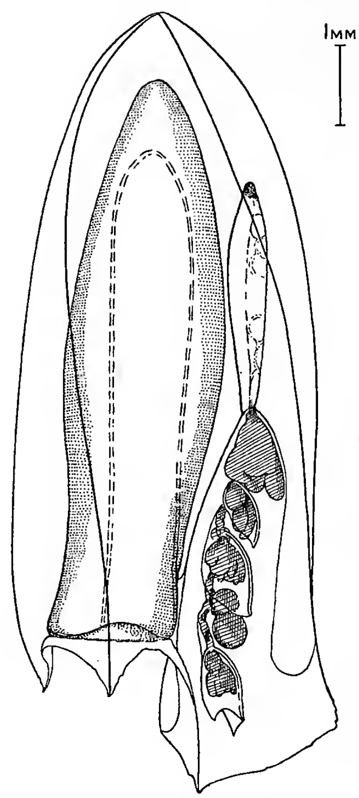
Through the kindness of Dr. L. F. de Beaufort and Dr. H. Engel, of the Zoölogisch Museum, Amsterdam, I was permitted recently to re-examine 91 of the Siboga specimens, namely 29 from St. 109, 33 from St. 117*a*, and 29 from St. 165. In none of them could I see any sign of a bud for an inferior nectophore. Moreover, there is no sign whatever in any of the innumerable Barrier Reef specimens that I have examined either of a posterior nectophore or of a bud.

A point of interest that does not appear to have been recorded about this species is that in it, as well as in the related *D. dispar* and *D. bojani*, is to be found a *rete mirabile* or "Gefässplatte" at the velar end of each of the four subumbral canals. That of the ventral canal extends the whole way from the circular canal to the peduncular canal, and the laterals are given off from its forward side. The others are smaller.

Although there are no specimens in this collection of the most primitive member of the genus, *D. antarctica*, it may be useful to point out in this place that in that species the "Gefässplatte" is found in its least specialized form. Other primitive features of that isolated species are the still divided mouth-plate, and the fact that the unspecialized swimming-bell of the eudoxid still functions as a gonophore.

The polygastric stage of *D. chamissonis* (Text-fig. 29) has been figured by Huxley (1859), Browne (1904), Lens and Van Riemsdijk (1908), and Moser (1925), who also figured the eudoxids. In addition Bigelow (1913, 1919) and Browne (1926) have added to our knowledge of the species.

Moser's figure represents a young specimen 2 mm. in length, viewed from the left side. It illustrates the curved dorsal ridge or keel at that stage. In mature specimens the keel is straighter at the after end, as in Browne's figure. The ventral wall of the nectosac in Moser's specimen appears to have collapsed. Browne has figured this wall accurately. At the after end is the horizontal " Gefässplatte." In front of the point where the peduncular canal joins this, the wall swells out abruptly to form a gentle curve towards the apex. Huxley, Moser, and Lens and Van Riemsdijk have figured the twisted left lateral ridge. That on the other side, figured by Browne, is straight. None of the figures except Lens and Van Riemsdijk's show the twisted ventral facet, the forepart of



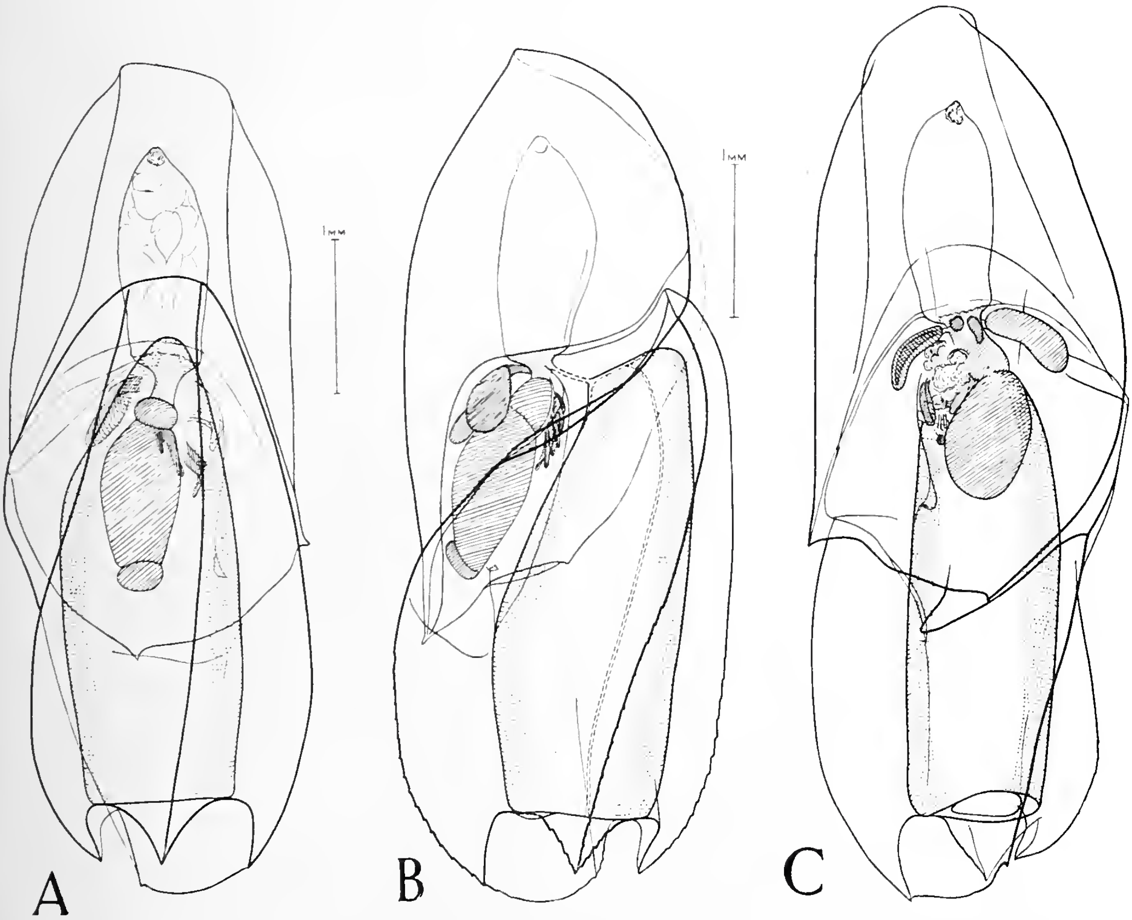
TEXT-FIG. 23.—*Diphyes chamissonis*, Huxley. ×10·5. Lateral view of the solitary (anterior) nectophore, to show the asymmetrical twist of the ventral facet.

which can be seen from the left side. Lens and Van Riemsdijk indicate this, but in their figure the after part of the facet does not return to the horizontal as it should. The after end of the right ventral ridge in their figure should be hidden by the end of the left ventral ridge. In Browne's figure the oral teeth and mouth-plate are abnormally short. The mouth-plate, which is seen in optical section in a side view, is five-sixths the diameter of the nectosac at its oral end. Browne's figured specimen is narrower than the majority that I have examined. The dorsal side of the somatocyst and hydroecium are in line, as shown by Browne, but the ventral sides meet at an angle as shown by Huxley, Lens and Van Riemsdijk and Moser.

The eudoxid (Text-fig. 24) was recorded for the first time, very briefly described, and rather inadequately figured by Moser (1925), and more fully described by Browne in the following year.

The two *Diphyes* eudoxids with normal bracts and special swimming-bells, *D. dispar* and *D. chamissonis*, can at once be distinguished by details of bract and bell, and by the way in which the two articulate.

Browne (1926) has commented on the difference in the shapes of the sutural surfaces. The plane of articulation between bract and bell in *D. dispar* is at right angles to the axial line, in *D. chamissonis* at 45°. In *D. bojani* it is almost parallel with it. When the bract of *D. chamissonis* is viewed from the right or left side it will be seen that the lengths of head-piece and neck-shield are about equal. In *D. dispar* the head-piece is



TEXT-FIG. 24.—*Diphyes chamissonis*, Huxley. × 20. A, Ventral; B, lateral; C, dorsal view of bract. The appendages are shown semi-diagrammatically.

50% larger. In *D. chamissonis* the dorsal wall of the head-piece is more convex. Owing to the forward extension of the articulating areas of bract and bell, the after-part of the sutural surface is more cut away and rounded off, so that this side, too, is convex. The apex of the head-piece is therefore much less pointed than in *D. dispar*, in which the dorsal and sutural surfaces are nearly straight, and meet at an acute angle.

In *D. chamissonis* the apical wall of the nectosac of the eudoxid bell is longer than in *D. dispar* and inclined at an angle to the axis, whereas in *D. dispar* it is very short and at right angles to the axis. The pedicular canal in *D. chamissonis* is very short in comparison with *D. dispar*, being shorter than the apical wall. The ventral teeth of

the special swimming-bell are connected by a convex plate which projects beyond them. The hydroecial cavity of the bract in *D. chamissonis* is shallow, and the tooth on the hydroecial " Leiste " is relatively smaller.

The sexes of eudoxids are separate, six or seven simple sac-like gonophores being produced. The females contain from six to eight eggs. A gonocalyx does not appear to form round the manubrium of the gonophore, as pointed out by Browne.

The reasons for assigning this eudoxid to *D. chamissonis* are the association between the eudoxid and the polygastric stage of that species, noted by Moser (1925) and Browne (1926), in the absence of other possibly related species, the similar association of stages from New Caledonia recorded above, and the special abundance of both stages at all times of the year near Low Isles, when other species were less abundant or absent.

Only four Diphyid larvae have been picked out from the various hauls. They measure from 0·7 mm. to 0·8 mm. in length, and from 0·4 mm. to 0·5 mm. in diameter, but are as yet without the rudiment of the future anterior nectophore. Three of them came from the weekly station three miles East of Low Islands in oblique hauls of the fine tow-net from 32 metres to the surface in January, at a time when no other diphyids but *D. chamissonis* were taken, so that they probably belong to this species. One other larva was taken in a closing net at 8 m. from the surface at the weekly station in October, at a time when other diphyids were also taken, so that it cannot definitely be assigned to this species. The larvae are conical in shape, the cylindrical broad-topped nectosac occupying about half its length. There is a very shallow hydroecial groove bounded below by a small rounded mouth-plate. Viewed from the aboral end the larva appears to be pentagonal in outline. The somatocyst is small, oblique and rudimentary, and a single siphon and tentacle are present. The course of the radial canals cannot be seen, but the pedicular canal joins them on one side instead of at the apex.

Chelophyes, gen. nov.

Genotype.—*Diphyes appendiculata,* Eschscholtz, 1829.

Generic Diagnosis.—Baso-dorsal and lateral teeth absent from both nectophores. Posterior nectophore retained, its basal lamella with two strong teeth.

Chelophyes appendiculata (Eschscholtz, 1829).

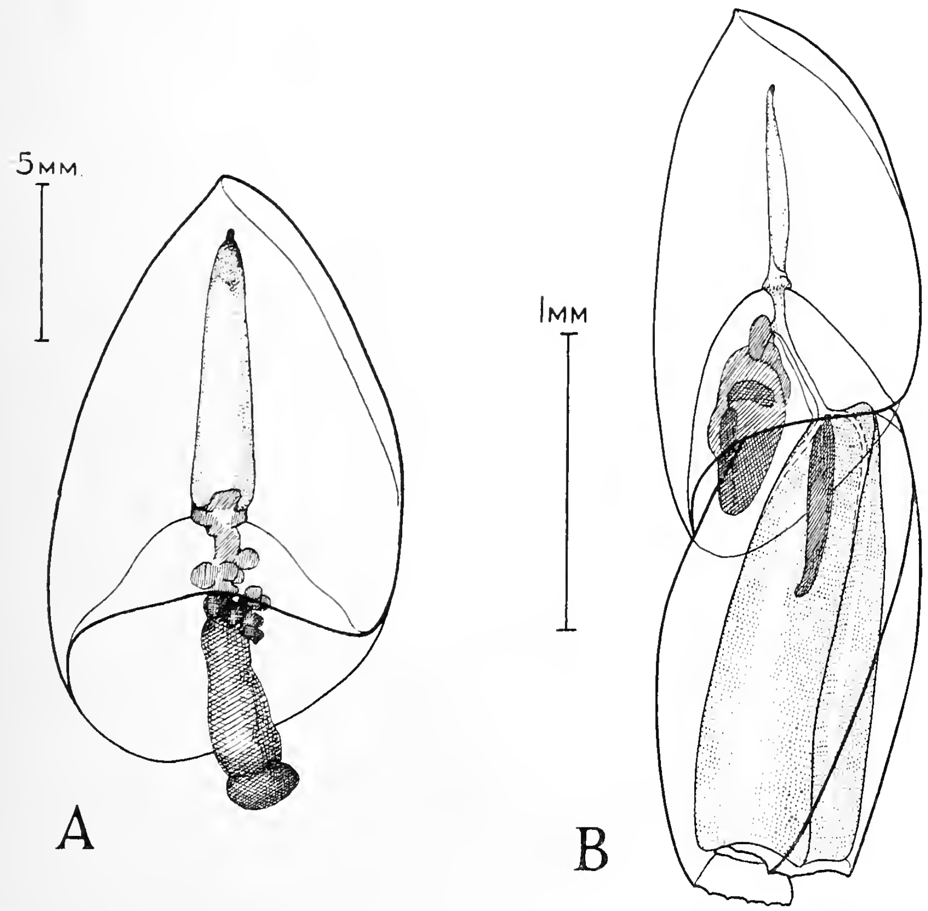
About 150 specimens were taken at both inside, outside and intermediate stations. The species was taken regularly in August, September, October and November, being perhaps most plentiful in September, when 62 of the specimens were taken in five hauls at three stations. It was found again outside on 18th March, and at the weekly station on 7th June. At St. 16 its vertical distribution was as follows :

Depth.	Number of specimens.
3·1 m.	9
8·0 m.	9
11·1 m.	1
12·5 m.	1
16·5 m.	2

It still seems to be doubtful which, if any, eudoxid is budded off by this species. In the 1-metre coarse silk tow-net haul at St. 19 were taken 4 complete specimens, 33 loose bracts, and 60 loose gonophores of a small eudoxid (Text-figs. 33–36), with neither special swimming-bell nor mouth-teeth, but with a rounded mouth-plate to its gonophores, and a pronounced bracteal cavity. They agree pretty well with Moser's descriptions and figure of *E. campanula* (1925, pl. xii), said to belong to *D. appendiculata*, but which, on account of its size and characters, appears to be more like a *Lensia* eudoxid. It will be convenient to deal with the specimens at this point. I give them the name *Eudoxia russelli*.

"*Eudoxia russelli*," sp. nov.

The bract (Text-fig. 25) resembles that figured by Leuckart (1853) on pl. iii, fig. 18, for his *E. campanula*. There is a deep bracteal cavity, the ventral wall meeting the sutural



Text-fig. 25.—*Eudoxia russelli*, sp. n. A, Lateral view of bract, × 41; B, lateral view, × 39, of a complete eudoxid, showing the deep bracteal cavity.

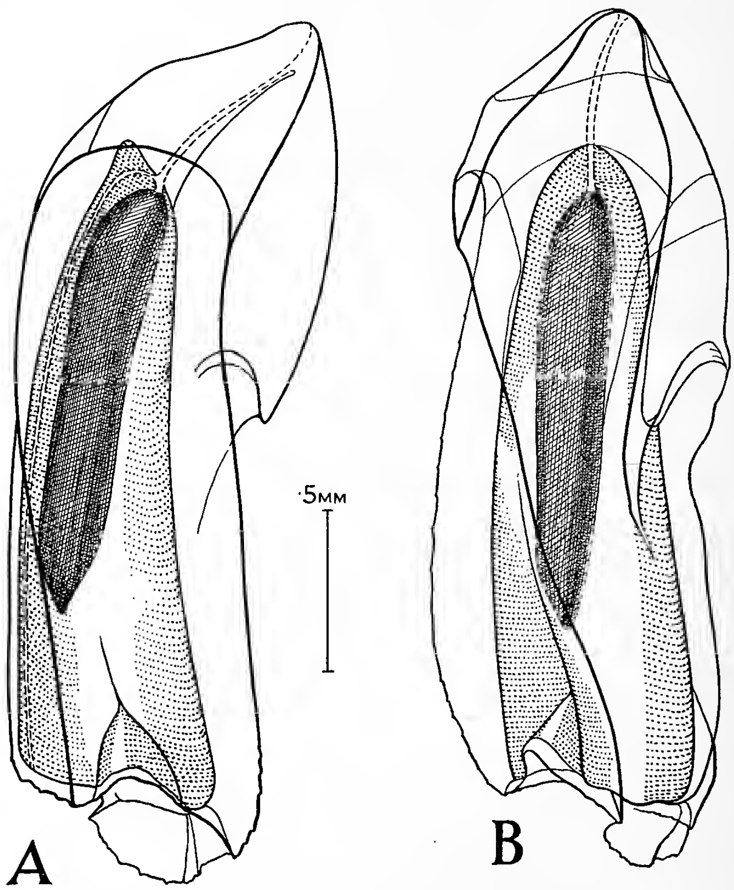
surface at an angle of 75°. The somatocyst in the better preserved specimens is cylindrical, with a tapered apex, and often an enlargement in the middle. It reaches nearly to the apex of the sutural surface.

The margin of the neck-shield of the bract is evenly rounded, and teeth cannot with certainty be distinguished.

The sutural surface ends posteriorly in a ridge, so that there is no articulation between it and the gonophore, the peduncle of which is completely within the bracteal cavity.

The second gonophore of each eudoxid, the sexes being separate as usual, is the mirror-image of the first.

There is in the middle of the right hydroecial wall (left wall of mirror-image) of the first gonophore an oblique basally projecting spur ridge (Text-fig. 26), dividing the basal from the proximal part of the twisted hydroecium. It sometimes forms a hook. The basal part of the hydroecial wall on that side is not produced into a high ridge, as are the other parts of the walls.



TEXT-FIG. 26.—*Eudoxia russelli*, sp. n. × 42. A, Lateral view; B, ventral view.

The two inconspicuous dorsal ridges, which end in small teeth, are connected at the level of the apex of the nectosac by an arched ridge. The left ventral and left dorsal (right dorsal in mirror-image) of the first gonophore are connected at the same level by a similar ridge. The ventral ridges are connected below by a rounded mouth-plate.

The gonophore's four radial canals lie under the ridges, the two dorsal ones curving over on either side of the pointed apical blind end of the nectosac.

The point in which these eudoxids differ from Leuckart's (1853) *Eudoxia campanula* is in the shape of the gonophore, which he described and figured (fig. 19) in some detail. The mouth-plate of his gonophore was not rounded, but toothed, and the dorsal wall of the nectosac is not S-shaped as figured and described by him.

The eudoxid figured by Moser (1925) on p. 245 has a shallow bracteal cavity, and the gonophore, which is probably deformed, appears to have no apical blind end. It seems to differ both from Leuckart's *E. campanula* and from *E. russelli*. Neither her description nor figure appear to be sufficiently critical for identification.

Moser cites as a synonym for the eudoxid stage of *D. appendiculata* the *Eudoxia messanensis* of Gegenbaur (1854). *E. messanensis* is described as having six longitudinal ridges on the gonophore, there being two lateral ridges which extend for half its length. The two dorsal ridges are described as terminating in teeth, but the two ventral as uniting in a projecting keel-like flap, presumably, and so illustrated, without obvious teeth. In these respects *E. messanensis* differs from *E. campanula*, Leuckart. The free eudoxid figured by Schneider (1896), pl. 45, fig. 30, under the name *D. appendiculata* has a gonophore whose longitudinal ridges do not end in teeth, and the details of which are not very convincingly drawn, so that it would be difficult to recognize it.

Chelophyes contorta (Lens and Van Riemsdijk, 1908).

This species occurred sparingly (specimens estimated at 50 in all) at outside and intermediate stations only, except for a comparatively large catch (estimated at 20) from the inside station 13, where specimens appeared earliest in the year. No intermediate or outside station appears to have been made in January, and no specimens are recorded for that month.

A specimen of this species was first recorded by Bedot (1896), who assigned it to *D. gracilis*, Gegenbaur, 1853. He figured a complete specimen from Amboina and a detached posterior nectophore. Some eudoxids which were associated with the polygastric stages he referred to Gegenbaur's *Eudoxia messanensis* without further description, except to state that they did not differ from the *Eudoxia campanula* of Leuckart. Moser, too, recorded the posterior nectophores of this species, having had for examination a complete specimen from the North coast of New Guinea, and many loose posterior nectophores from various localities. Bigelow (1919), recorded three specimens with buds of inferior nectophores.

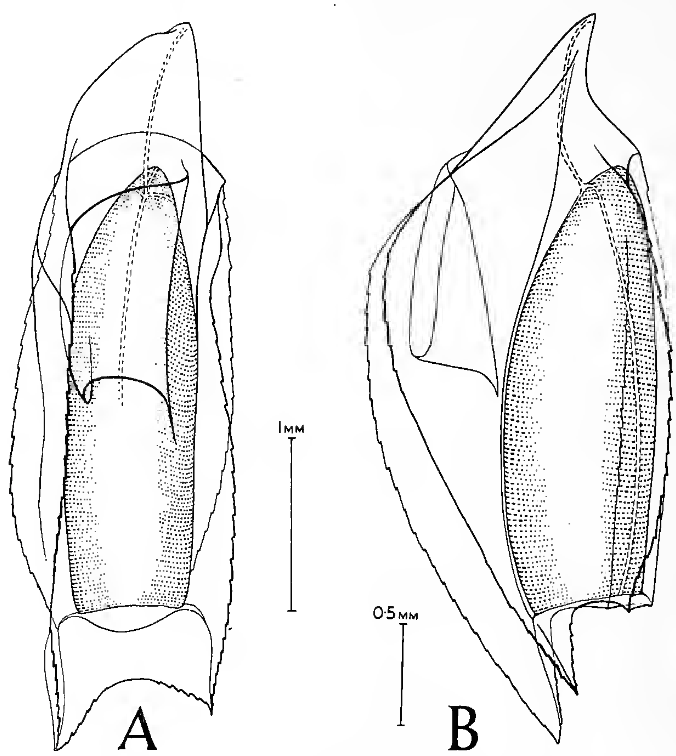
One specimen in the Barrier Reef Collection, 5·23 mm. in length, has within the hydroecium a young posterior nectophore measuring 0·85 mm. in length, and at least four other specimens have younger buds. From St. 26, at which these specimens with buds were taken come three loose posterior nectophores, and from St. 19 come four others, the largest of which measures 3·52 mm. × 1·52 mm.

Moser (1925) has already compared the posterior nectophore with that of *D. appendiculata*. In addition to the differences pointed out by her there are others which should be noted. In *D. contorta* the ventral ridges are relatively less deep near the mouth, but wider in the middle region, giving the ventral side a bowed appearance in lateral view. The peduncle is relatively shorter than in *appendiculata*, and the nectosac ends in a pointed blind end. The apical wall is oblique and runs into the dorsal wall without the marked angle that is usually seen in *appendiculata*, but this is not a constant character in that species. Moser's statement that Bedot's figure makes the length of the ventral teeth too much alike is confirmed by my observation that the right-hand tooth is the shorter in these specimens. The arrangement of the canals is similar to that found in *appendiculata*,

the dorsal and ventral median and two laterals being given off by the pedicular at a little distance from the apex.

The only eudoxids so far recorded as attributable to this species are those found at Amboina, and referred by Bedot (1896) to Gegenbaur's *E. messanensis*. The present material has provided no evidence on this point.

Lens and Van Riemsdijk's original description is worded badly, but Bigelow (1919) seems to have made a slip in alleging that they stated that there were five ridges at the apex.* They described and figured three in their fig. 49. Bigelow himself (1911*b*, pl. 8, fig. 3) figured correctly only three ridges meeting at the apex, and evidently made a second



TEXT-FIG. 27.—*Chelophyes contorta* (Lens and Van Riemsdijk). × 25. A, Ventral view of posterior nectophore to show the right hydroecial fold ; B, lateral view of the same nectophore.

slip in stating (1919) that there were four. The left ventral and dorsal ridges do not reach the apex in the Great Barrier Reef specimens.

Eudoxoides, Huxley, 1859.

GENOTYPE.—*Diphyes mitra*, Huxley, 1859.

Eudoxoides mitra (Huxley, 1859).

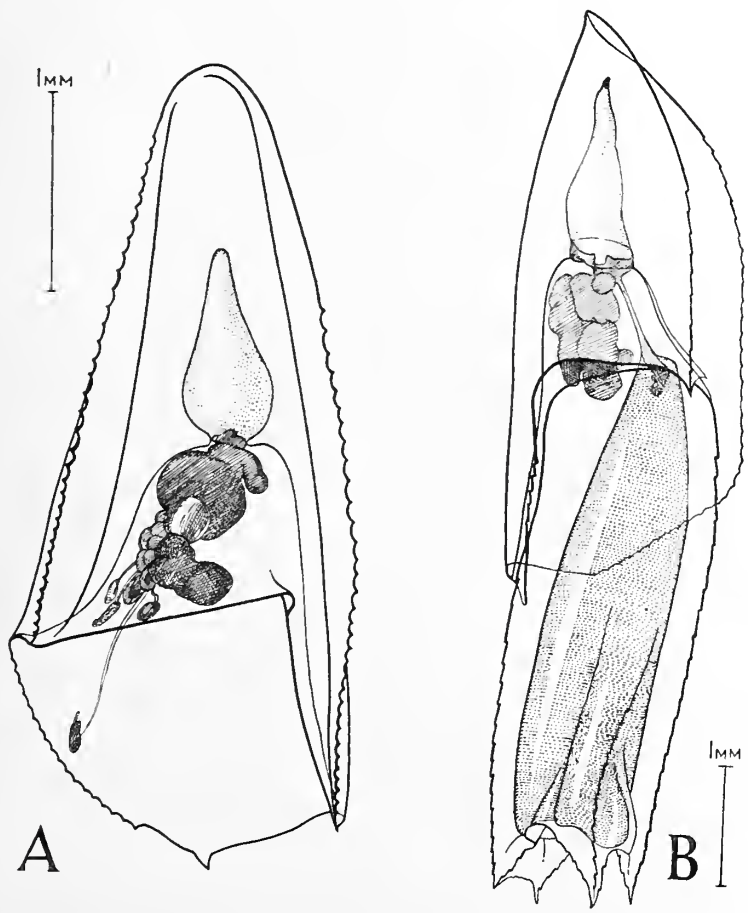
Syn.: *Eudoxoides sagittata*, Huxley, 1859.

Sixteen specimens of the polygastric and fifteen of the eudoxid stage were taken. Outside stations were made only in October, November, February and March. The

* Bigelow (1911*b*) alleged that the authors of the species stated that there were four ridges at the apex.

species occurred at all except the February one, and also at an intermediate one in Trinity Opening on 19th November. But it was taken only four times at the weekly station, three miles E. of Low Isles, on 11th and 20th September, 3rd October, and 27th December.

The bract of the eudoxid was well figured from two view-points by Huxley (1859). Bracts of mature eudoxids are often broader in proportion to length than shown by him. The edge of the posterior embayment is not generally so strongly toothed, and the posterior right marginal tooth does not extend so far behind as is shown in his upper view, fig. 1. The left sutural ridge curves off broadly at the hinder end of the bracteal cavity to meet



TEXT-FIG. 28.—*Eudoxoides mitra* (Huxley). A, Ventral view of the bract of the eudoxid, × 26; B, lateral view of a complete eudoxid, × 16.

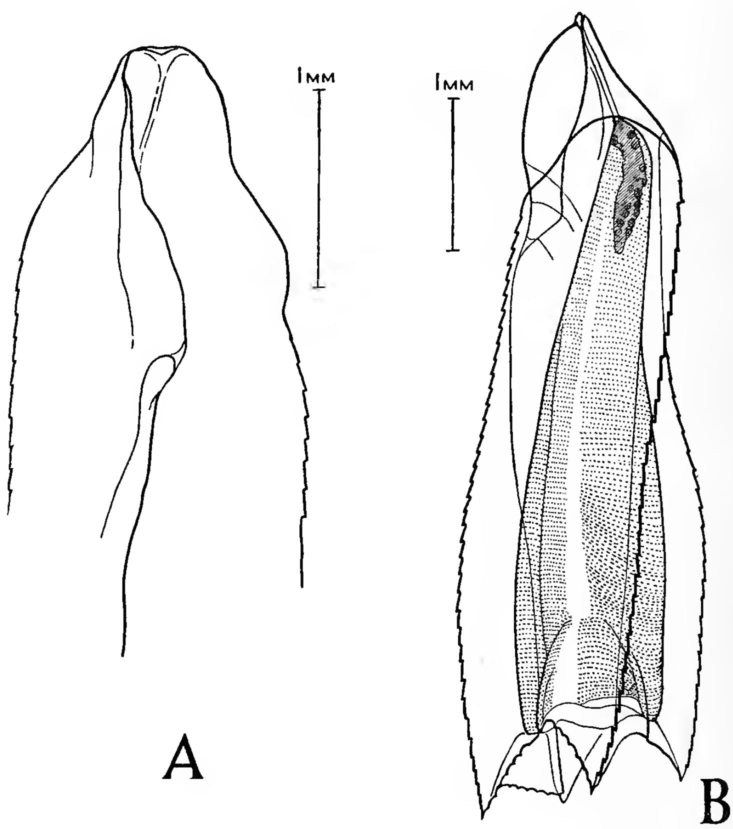
the posterior embayment, and does not form the angle shown in his lower figure. Huxley did not indicate the serration of the posterior parts of the sutural ridges of the bract in his lower view, and emphasized it too much in his upper view.

Lens and Van Riemsdijk's figure of the eudoxid (1908, pl. vii, fig. 62) is good. They have drawn a specimen whose bract has an abnormally recurved tip and an abnormally squat somatocyst, but they indicate the correct amount of twist in the gonophore.

Bigelow's (1911*b*) fig. 9 of plate 11 is a good representation of this eudoxid, but the bract as drawn is unnaturally twisted round relatively to the gonophore. When the gonophore is viewed from that direction the sutural surface of the bract is seen edge on.

The bract usually extends further down the gonophore than is shown. Moser's fig. 11 of the whole eudoxid is good. In her fig. 7 the contour of the posterior part of the bract is not good.

The nectosac of the gonophore (Text-fig. 29B) is quadrangular, and the radial canals lie on the corners under the ridges. At the level of the apex of the nectosac there are low rounded ridges connecting the right dorsal and right ventral ridges, and right and left dorsal ridges. These connecting ridges mark the contact with the bract, that on the dorsal side lying at the oral margin of the sutural surface. The area proximal to these connecting



Text-fig. 29.—*Eudoxoides mitra* (Huxley). A, Ventro-lateral view of the apex of a gonophore, × 26, to show left hydroecial fold; B, view of right side of a female gonophore of a eudoxid, × 20.

ridges is the apophysis or peduncle. It is convexly rounded on the dorsal side, where it fits into the bracteal cavity and slopes off from the connecting ridges to its apex. On its ventral side (Text-fig. 29A) it is concave in section, and is continuous with the proximal parts of the two ventral expanded ridges that form the hydroecium.

Eudoxoides spiralis (Bigelow, 1911*b*).

Material.—Specimens of the polygastric stage appeared sparingly between 17th August and 18th March, 1928, at both deep water stations and inside the Barrier, as well as intermediately as follows :

Station number.	Depth from which an open net was fished to surface.
6	32 m.
8	45 m.
10, 12. 14, 15, 18	32 m.
19	180 m.
20	250 m.
26	57 m.
28	580 m.
34	32 m.
49	46 m.
50	400 m.

The total number taken at these stations was estimated at 168. It is quite possible that *E. spiralis* was taken at other stations, but that it has been overlooked. Very few eudoxids were noticed in these catches.

At St. 16, where a closing net was fished at six depths between 10.13 a.m. and 12.27 p.m., specimens of *E. spiralis* occurred in the catches as follows :

	Surface.	3·1 m.	8 m.	11·1 m.	12·5 m.	16·5 m.
Polygastric stage	0	6	10	0	0	1
Eudoxid stage	1	2	5	2	0	21

In the catches from the eighteen hauls of closing nets fished at Sts. 62, 65 and 68 on 15th June, 10th and 18th July, 1929, respectively, a single specimen of the polygastric stage was found. It came from a depth of 50 m. at about midday. There is evidence, then, that the polygastric stage extends in daylight from 3 to 50 m. from the surface, and the eudoxid from the surface down to 17 metres ; but there is no evidence that these are the limits of its vertical distribution in daylight in the Barrier Reef region ; indeed, five specimens were taken in the Bottom Stramin Plankton net which was fished on the bottom at 205 m. at St. 29 on 24th November, but they may have been taken anywhere between the bottom and the surface.

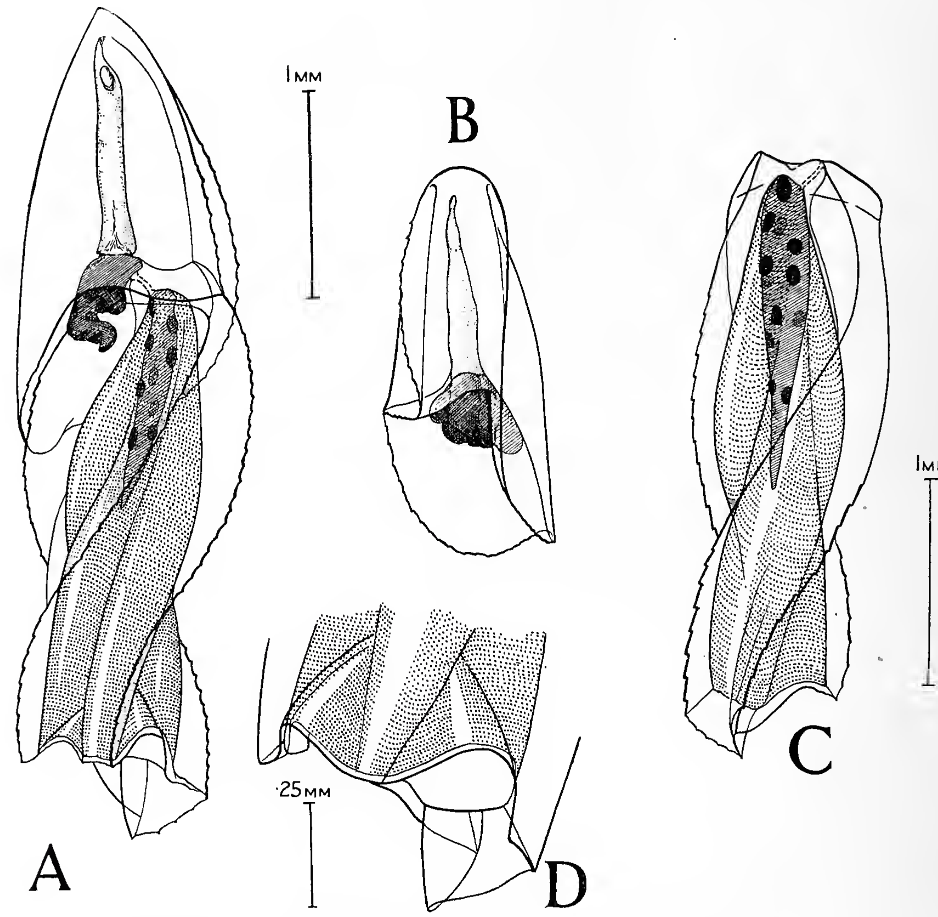
Browne (1926) records the capture of this species in the Indian Ocean by self-closing nets as follows :

457–914 m.	1 eudoxid.
At 914 m.	1 anterior nectophore.

He did not state whether or not the hauls were made in daylight.

The eudoxid (Text-fig. 30A) has been figured by Moser (1925), who so far has given us the only account of it. Her fig. 8, pl. 1, will be found to show the mirror-image of the bract figured immediately above it in fig. 9. In no species have I observed such enantiomorphism of the bract. The bracts of eudoxids appear to be always of one kind. As this question is not mentioned in the text, the drawing of fig. 8 may be an artist's error. The gonophores, presumably first and second respectively, are mirror images of one another as in *Diphyes dispar* and *E. mitra*. The details of Moser's fig. 9 do not correspond very closely with those of the present specimens, although the eudoxids of this species

are peculiar enough to be instantly recognizable. The dorsal and left sides of the neck-shield (Text-fig. 30B) are at right angles to one another, with a rounded instead of a pointed embayment between them. The dorsal half projects as a rule further aft than that of the left side, and the right-hand side is more cut away posteriorly than in the one figured by Moser. The whole neck-shield is rather larger in proportion than she has represented it to be.



TEXT-FIG. 30.—*Eudoxoides spiralis* (Bigelow). A, Lateral view of a complete eudoxid, × 27, to show the twisted gonophore; B, ventral view of a bract of a eudoxid, × 27, to show the absence of large teeth on the edge of the neck-shield; C, lateral view of a detached female gonophore, × 27, to show the very short pedicel; D, enlarged view of the base of the gonophore shown in A, × 54.

The gonophores (Text-fig. 30C) are spirally twisted rather more than one quarter of a turn to the left or right, according to the order of appearance, presumably. The pedicular canal is very short, and there is no apparent peduncle, the two walls of the hydroecium arching inwards towards the apex of the nectosac, and over to meet each other. Between this point and the dorsal side, where the two dorsal ridges are connected by a flat asymmetrical arched ridge, there is a slightly depressed "saddle-area" which articulates with the bract. On the right side* of the first gonophore a low arched ridge connects

* The terms "right" and "left" are interchangeable according to whether the gonophore referred to is the first or second.

the tops of the dorsal and ventral ridges. The right dorsal and right ventral corners of the upper truncated surface of the gonophore are sloped off to the respective longitudinal ridges. On the left side there is a very slightly marked ridge separating the saddle-area from the concave left side of the gonophore. The ventral longitudinal ridges which form the hydroecial walls broaden gradually in the promixal third of their length. The right-hand one is interrupted as a rule at a third of its length from the truncated apex by the vestige of an obliquely descending projection, which in other species forms a hydroecial tooth. At this level is often observed a line or crease running across the outside of the left hydroecial wall of the gonophore. The distal extremities of the ventral ridges are connected by a semicircular mouth-plate.

Live polygastric specimens examined by me in March, 1931, in the Bay of Algeciras were found to be relatively very rapid "darters" that took an open spiral course. In their habits they are strongly contrasted with specimens of such slowly moving species as *A. tetragona*.

Dimophyes, Moser, 1925.

Genotype.—*Diphyes arctica*, Chun, 1897.

Moser's generic name may be used conveniently for Chun's species, whose systematic position was left out of the discussion on p. 345.

Dimophyes arctica (Chun, 1897).

One eudoxid, 3·6 mm. in length, of this species was taken at St. 28, outside Trinity Opening on 23rd November, in a vertical haul from 580 m.

The eudoxid of this species is easily recognized by its long neck-shield containing a descending branch of the phyllocyst, which also gives off an apical branch. There are no marked ridges or mouth teeth, but a very inconspicuous shallow rounded mouth-plate is present.

This species has a very much wider distribution than was supposed some years ago. It occurs in both the Arctic and Antarctic, being particularly common in the subantarctic; throughout the Atlantic; in the Indian Ocean (Port Natal, Moser); between Providence and Alphonse Is. (Browne, 1926); in Sagami Bay, Japan (Moser); and in the Northern Pacific (Bigelow, 1913). The present record from the Barrier Reef therefore helps to fill in a large gap.

Genus *Lensia*,* gen. nov.

Genotype.—*Diphyes subtiloides*, Lens and van Riemsdjik, 1908, p. 46, pl. vii, figs. 59–61.

Small diphyid Calycophorae, with pentagonal anterior and smaller fragile posterior nectophores. The anterior nectophore has a very shallow hydroecium, a short and divided mouth-plate and no dorsal or lateral teeth. Its radial canals have no commissures, and its somatocyst is short or of medium length.

* Not to be confused with *Lenzia*, Kieffer, 'Ann. Soc. Sci. Bruxelles,' XLI, p. 360, 1922. My colleague, Dr. F. W. Edwards, tells me that *Lenzia*, Kieffer, is sunk in the synonymy of *Phaenopsectra*, Kieffer, 1921 (*Chironomidae*).

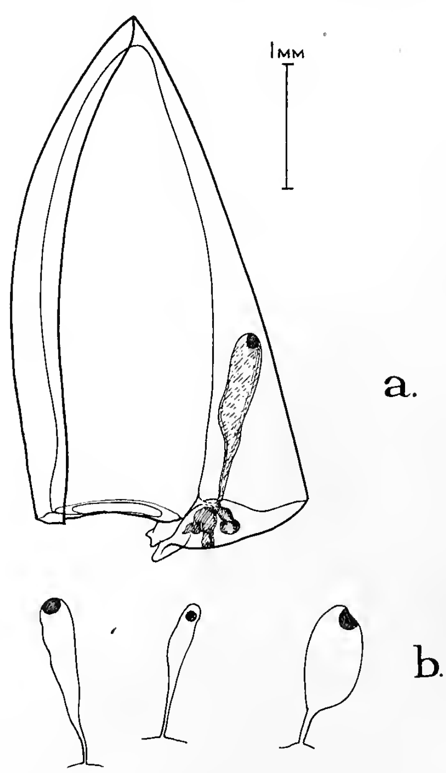
The posterior nectophore is truncated anteriorly, has a rounded mouth-plate and no teeth. The lateral radial canals are not looped.

The eudoxid has no special swimming-bell. Its bract has a broad rounded posterior edge without teeth, and its gonophores are truncated anteriorly, with small dorsal teeth, and with narrow rounded mouth-plate.

Very numerous specimens that correspond closely with Lens and Van Riemsdijk's *Diphyes subtiloides* occur in most of the catches inside the Barrier Reef. Some of them have a mature fragile posterior nectophore. It appears to be desirable to associate in a separate genus this *Diphyes subtiloides* of Lens and Van Riemsdijk with three other small Diphyids—*Diphyes subtilis*, Chun, 1886, *D. fowleri*, Bigelow, 1911, and *D. truncata*, Sars. With them may be included some so-called *Galeolaria* species—*G. campanella*, Moser, and *G. multicristata*, Moser. This authority had included *D. subtiloides*, Lens and Van Riemsdijk, and *D. fowleri*, Bigelow, in the synonymy of *G. truncata*. I have examined thousands of specimens of *D. subtiloides*, numerous specimens of *G. truncata* from Hjeltefjord, near Bergen, as well as the type and seven paratypes of *D. fowleri* in the Museum, and ten more kindly lent by Dr. Bigelow. There is nothing approaching transition from one of these species to another, and I recognize the three species as distinct.

Lensia subtiloides (Lens and Van Riemsdijk, 1908).

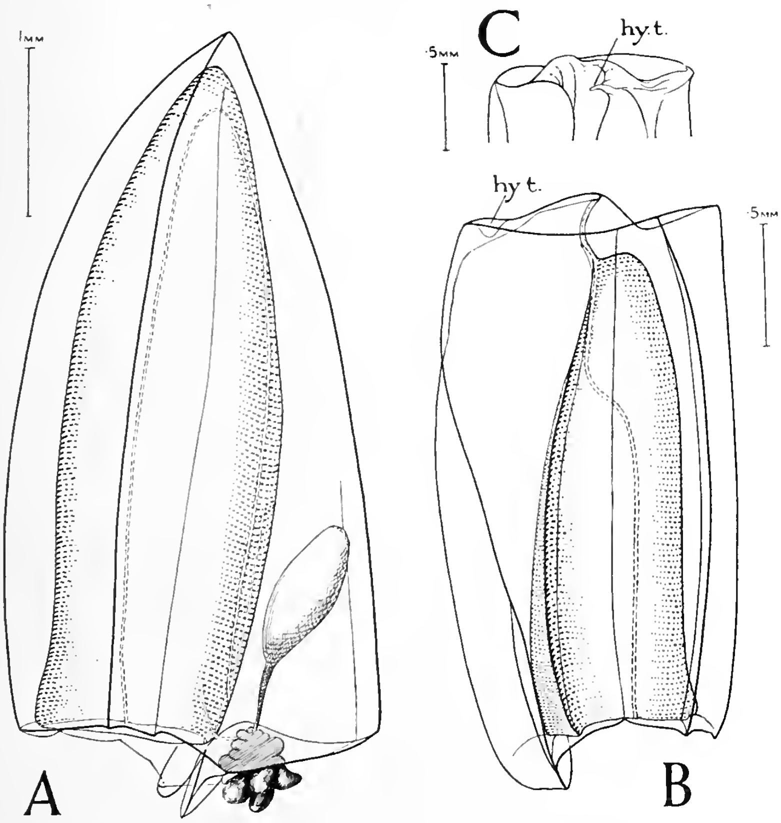
Occurrence.—This was perhaps the most abundant species, nearly 1300 specimens of the polygastric stage having been taken at St. 16 alone, where its vertical distribution



Text-fig. 31.—*Lensia subtiloides* (Lens and Van Riemsdijk). × 16. *a*, Anterior nectophore; *b*, three separate somatocysts, to illustrate the range in variation in the shape of that organ.

was studied. Here the bulk of the specimens were at a depth of 8 metres in the day-time, many more being taken between that depth and 12·5 metres. The time of its greatest abundance seems to have been from the beginning of December to the middle of February. It was absent from two intermediate stations at the end of February; also from the weekly station on nine occasions between April and July, and on seven occasions in August and September.

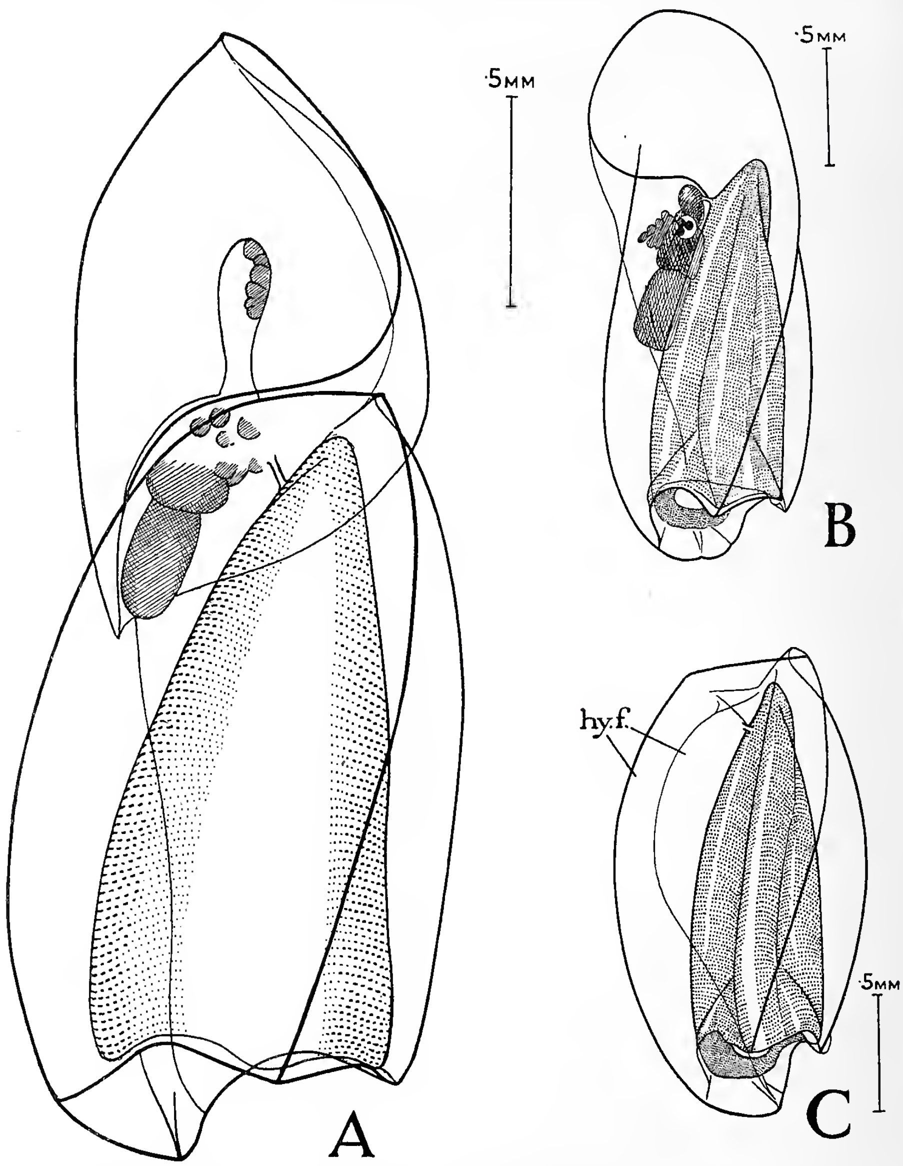
DESCRIPTION.—The resemblance between the very numerous specimens and Lens and Van Riemsdijk's description and fig. 59 is so close as to make it certain that we are dealing with their species. The larger anterior nectophores are from 4·5 mm. to 5 mm. long



TEXT-FIG. 32.—*Lensia subtiloides* (Lens and Van Riemsdijk). A, Anterior nectophore, × 22; B, posterior nectophore, × 32, to show the course of the lateral radial canal, and the tooth *hy. t.*, at the apex of the right hydroecial fold; C, ventral view of the apex of the posterior nectophores, × 23, to show the tooth of the right hydroecial fold.

and 2 mm. deep. The smallest anterior nectophore is 0·62 mm. in length and 0·37 mm. in depth. The specimens vary very little in the shape of the somatocyst (Text-fig. 31). This differs slightly from that figured by Lens and Van Riemsdijk. The summit of the very shallow hydroecium of the anterior nectophore is level with the mouth of the nectophore. The distance between the base of the somatocyst and the mouth-plate is about half that between it and the ventral wall. The peduncle of the somatocyst which arises from this point may be distinguished as a fine canal for a distance of between one-fourth and one-half the length of the somatocyst before gradually passing into it. The anterior end of the somatocyst is rounded, and lies near the ventral wall, the axis of the somatocyst being inclined towards that side from its base, which with its peduncle lies nearer the

nectosac. The somatocyst of average specimens varies in length from 0·54 mm. to 0·66 mm., and in diameter from 0·23 mm. to 0·28 mm. The course of the subumbral canals was not observed by lens and Van Riemsdijk. In a Barrier Reef specimen measuring 3·41 mm. in length the lateral canals run up, without any cross connection



Text-fig. 33.—*Lensia subtiloides* (Lens and Van Riemsdijk). A, Lateral view of a complete eudoxid, × 55 ; B, right lateral view of a detached gonophore with enlarged apex, × 31 ; C, similar view of a normal, detached gonophore, to show the hydroecial folds, *hy. f.*

with the ventral canal, to within a distance of 0·20 mm. of the anterior end of the nectosac, and of 0·37 mm. of the apex of the nectophore, before bending back on a parallel course to meet the ring canal.

Differentiation.—The anterior nectophore (Text-fig. 32A) is similar in general outline to that of *L. truncata* (Sars), but differs from it in the following ways : The two lobes of the mouth-plate are almost equal in size, whilst in *truncata* the right is the larger. And instead of being flush with the posterior end of the nectophore, as they are in *truncata,*

they project posteriorly. The anterior wall of the hydroecium extends forward to the level of the opening of the nectocalyx, which is not the case in *truncata*. Also the somatocyst is relatively shorter and has a longer, though not sharply differentiated pedicel than that of *truncata*, whilst the dorso-basal tooth is relatively smaller. The posterior nectophore (Text-fig. 32B) does not exhibit the diverticulum in the nectocalyx anterior to the entry of the pedicular canal that is characteristic of *truncata*.

The eudoxids (Text-fig. 33A) are similar to those of *truncata*. Mature gonophores are rarely found attached to the bract. In the numerous preserved eudoxids of *truncata* that I have examined only young buds of gonophores were present, although detached mature ones were abundant in the tow-nettings. The bracts of *truncata* eudoxids, like those of *subtiloides*, have no projections on the posterior margin, such as are found in species of *Diphyes*. The two species are very closely related, but quite distinct from one another.

In *Lensia subtilis* (Chun) the fine peduncle is much longer in proportion, and the somatocyst globular.

Lensia subtilis (Chun, 1886).

One complete specimen, twelve anterior and two posterior nectophores in all were taken from three stations outside Trinity Opening, 19, 20 and 28, on 20th October, 19th and 23rd November respectively.

The condition of the material is not such as to enable me to add much to our knowledge of this species. Although the presence of the globular stalked somatocyst is a distinctive character which marks out typical specimens of this species from those of any other that we know at present, the amount of variation in length of this stalk is not known.* There are eight other poor specimens with shorter stalked somatocysts which probably belong to the species, but until this question of variation has been determined in a large series of specimens, it is useless to make a definite assignation of such material.

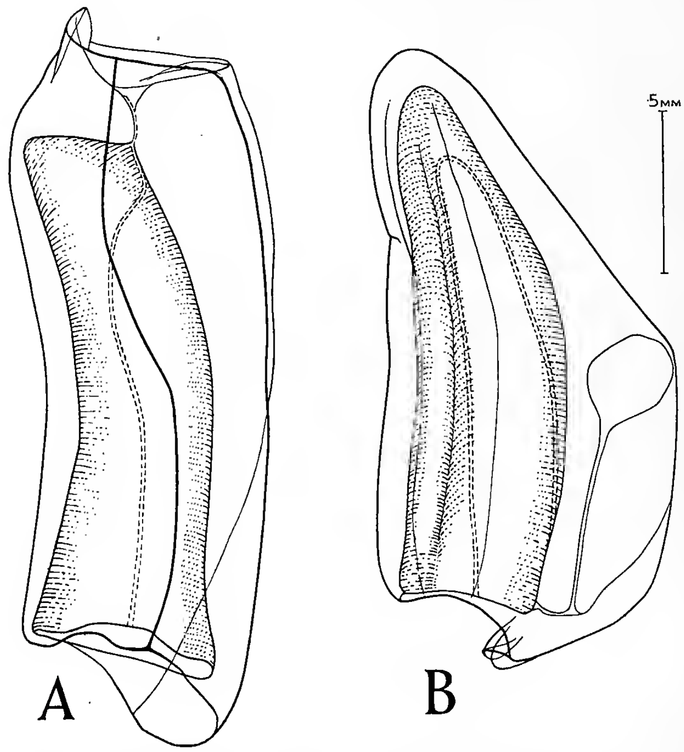
The species has been recorded from the Mediterranean (common); the Atlantic, from the Bay of Biscay (52°–66° F.) to latitude 35° S.; the Indian Ocean, Madagascar, Rodriguez, Chagos; and off New Guinea (N.E.).

Chun (1886) described but unfortunately did not figure the eudoxids which he raised from the polygastric stage of this species. He said that without doubt they were identical with Will's *Eudoxia elongata*. The fig. xxx, given by Will (1844) is not very easy to interpret, but it appears to show a gonophore without any bract, although Will labelled part of it the "Athemhöhle" or phyllocyst. Chun's judgment, however, cannot be lightly disregarded, since he had active living eudoxids before him; but it is difficult properly to interpret Will's figure, and not possible to substitute his name *elongata* for Chun's, since it was preoccupied by Hyndmann (1841). It should be borne in mind that *subtilis* is a very common Mediterranean species, and that it is very likely that Will did have its eudoxid before him as well as those of the other two species he figured, namely *Muggiaea kochii* and *Sphaeronectes kollikeri*. The gonophores should be easily recognizable by the peculiar canal system described by Chun, but his account does not appear to have received any subsequent confirmation. The eudoxids found by Moser at Villefranche and Monaco and assigned to this species had normal canal systems. There would appear, therefore, to be some doubt as to what the eudoxids of this species are really like.

A characteristic feature is the way in which the furrowed basal facet, or hydroecium,

* Lens and Van Riemsdijk (1908) took specimens at Naples every day during January and February, 1906. They reported that in all these specimens the somatocyst had "a long thread stalk."

of the anterior nectophore slopes away anteriorly into the ventral facet (Text-fig. 34A). In the posterior nectophore at its anterior end is a projection of the dorsal wall that evidently fits closely into the anterior nectophore at this point. The two nectophores are drawn by Moser in her text-fig. 29 as being very loosely coupled, and with the dorsal side of the posterior and anterior nectophores on one and the same side of the longitudinal axis. I suggest that these are post-mortem phenomena.



TEXT-FIG. 34.—*Lensia subtilis* (Chun). × 42. A, Left lateral view of a posterior nectophore, to show the course of the lateral radial canal; B, left lateral view of an anterior nectophore, to show the hydroecium.

Another feature of this species is the shape of the blind end of the nectosac in the posterior nectophore. There is a considerable anterior wall, which makes nearly a right angle with the dorsal wall.

Lensia campanella (Moser, 1925).

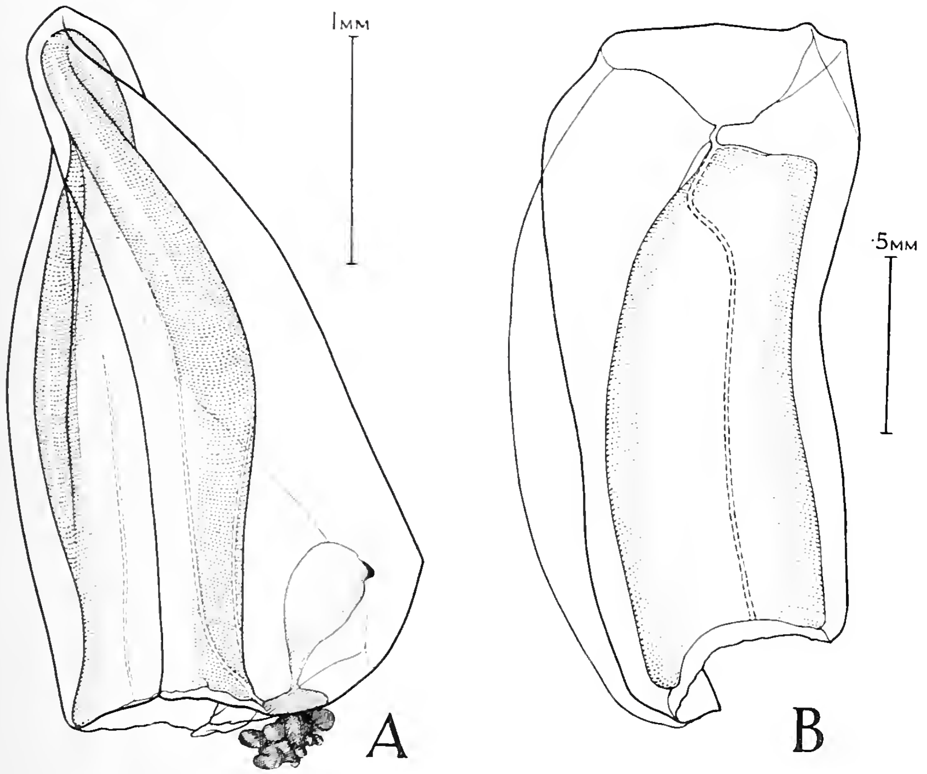
One anterior nectophore was taken with the coarse silk net, and three more with a single posterior nectophore in the stramin net at outside St. 19 on 20th October; one anterior nectophore at intermediate St. 49 on 17th March; and one anterior nectophore at St. 50 outside Papuan Pass on 18th March, all being taken in vertical hauls of open nets.

This is a very small species, of which only seven anterior and a single posterior nectophore have been described hitherto. It is said to be cosmopolitan. Previous records are: Tortugas; W. of Colombo, Ceylon; and German New Guinea.

The largest anterior nectophore in the collection measures 3·33 mm. in length, and the smallest 1·85 mm.

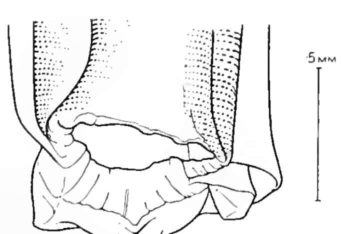
Both anterior and posterior nectophores (Text-fig. 35) are of the same general build

as those of *L. subtiloides* and *L. subtilis*. The mouth-plate is very small indeed and divided (Text-fig. 36), and the longitudinal ridges are scarcely visible. The tip of the nectophore is twisted through nearly half of a complete turn. The small size, the twisting, the well-



TEXT-FIG. 35.—*Lensia campanella* (Moser). A, Left lateral view of an anterior nectophore, × 30, to show the asymmetrical twist; B, right lateral view of a posterior nectophore, × 46, to show the course of the lateral radial canal.

preserved musculature, the shape of the somatocyst and the oblique sloping off of the ventro-basal facet all point to identity with Moser's species, and yet the longitudinal ridges do not run as shown in her figure. But basing my judgment on my experience of



TEXT-FIG. 36.—*Lensia campanella* (Moser). × 35. Ventral view of the base of an anterior nectophore, to show the small size of the mouth-plate, *m.p.*

the extent to which Moser's figures correspond with actual specimens, I feel confident that these specimens belong to this species. On account of its great size there appears to be some element of doubt as to whether the large specimen, 11 mm. in length recorded by Moser from W. of Colombo, really belongs to the same species. Unfortunately this is the

specimen selected for Moser's figure, pl. iv, fig. 1. I regard the specimens from German New Guinea as the typical forms, and select the larger one taken in 1910 as the holotype. Moser figures a well-marked right lateral ridge in the anterior nectophore. In the Australian specimens it is the right and left ventral ridges and the ventral facet that take part in the twist, the right lateral ridge being practically suppressed. Viewed from the oral end the nectosac appears to be lobed. There is a large ventral lobe, a left lateral and a dorsal. The latter is not in the median line, but balances the left lateral. Towards the apex it can be distinguished as a double lobe, the dorsal predominating in size over the right lateral. In short, viewed from the right side no lateral ridge such as drawn by Moser can be seen, and in this respect the Australian specimens differ from the Colombo one figured by Moser. Viewed from the ventral side the somatocyst is seen to be displaced towards the left ventral ridge. All the ridges are very low, and can only be seen in an oral or apical view. The somatocyst has a very short pedicel, is relatively large and globular or ovoid in shape, and lies obliquely, closely applied to the basal wall of the nectophore.

Whilst collecting in the West Indies in H.M.S. " Rodney " in 1931, I took two specimens of this little-known species off Kingstown, St. Vincent, at the surface at night in February.

Lensia fowleri (Bigelow, 1911).

A single anterior nectophore, 4·8 mm. in length, was taken at St. 28, outside Trinity opening, on 23rd November. The state of preservation is not good, but the specimen was compared directly with types kindly supplied by Dr. Bigelow, and also with *L. truncata* from Norwegian waters.

The somatocyst occupies the position characteristic for *fowleri*, but is shrunken, as it often is in that species. In two respects it agrees very closely with the types and differs from *truncata*. The apex of the nectosac reaches very nearly to the apex of the nectophore; and the dorsal longitudinal ridge is comparatively shallow, and does not project beyond the opening of the nectosac. These two points may escape attention unless specimens of the two species are closely examined side by side. The differences, however, are clear cut, and furnish two more useful characters for the separation of these two species. The lateral ridges at their oral ends slope back in a characteristic way towards the mouth-plate, and the lateral radial canals lie almost directly under the ridges. All of the ridges are rather obtuse-angled.

In *Lensia fowleri* (Bigelow) the somatocyst is nearly globular, and extends down to the posterior end of the nectophore on the ventral side of the hydroecium. Its summit extends well above the level of the mouth of the nectophore, which reaches a much larger size than in *Lensia truncata* and *L. subtiloides*. The figures of the somatocyst and hydroecium of *L. fowleri* given by Bigelow (1911*b*) do not very closely represent the conditions found in the Museum's seven syntypes, and in ten more from the Museum of Comparative Zoology, Cambridge, Mass., kindly loaned by Dr. Bigelow. The hydroecium is confined to a very small space on the dorsal side of the somatocyst. In all cases the somatocyst had partly collapsed, but there was sufficient indication of the space that it originally occupied.

Lensia, spp. indet.

From St. 20, outside Trinity opening, come seven small specimens of a species of *Lensia* from 3 mm. to 4·8 mm. in length. The five longitudinal ridges are distinct.

The somatocyst, which is short, unstalked and oblique, is 0·6 mm. in length in the longest specimen. The dorsal ridge is not so deep as in *G. truncata* from Norwegian waters, and it does not project so far beyond the velar level. Three of the specimens are fairly well preserved, but it is not possible to say definitely whether the lateral ridges reach the level of the velum owing to longitudinal folding of the nectophore walls. The basal plane is oblique to the longitudinal axis owing to the shortness of the ventral wall. The mouth-plate is short, and divided with rounded inner angles. The two lateral canals come off separately at varying levels from the base of the ventral canal. The canal system is normal.

Probably these specimens will prove, later on, to belong to a new species, but since it is not possible to give a sufficiently critical description of it owing to the condition of the specimens, it is not proposed at this time to establish the new species, but to wait until more material becomes available.

Two specimens of what will probably prove later on to be another new species come from St. 50, outside Papuan Pass. Some description of them may be given, although it is not intended thereby to establish the species. The lateral ridges do not reach the velar level, and the dorsal ridge is very shallow. The inner angles of the two flaps of the mouth-plate are but very slightly rounded, and project down further than the outer angles. The somatocyst is about half the length of the nectophore. The hydroecium, which is entirely below the level of the velum, is more extensive than in *G. truncata* from Norwegian waters, and is continued as a very shallow depression on to the lower part of the ventral facet. Thus there is no sharp ventro-basal ridge as in *G. truncata*.

The two specimens, neither of which is in a good state of preservation, measure about 10·5 mm. in length. They closely resemble the specimen figured by Bigelow (1911*b*), plate 12, fig. 2, and called ? *Muggiaea kochii*, but later (1913) referred to as *Diphyes truncata*, Sars. Sars's species, however, judging by specimens kindly provided by the Bergens Museum Biological Station, is quite distinct.

One eudoxid, 1·8 mm. in length, with a rounded bract and short cylindrical upright phyllocyst, together with fourteen gonophores measuring from 1·2 mm. to 3·9 mm. in length, were taken at St. 20, outside Trinity opening on 20th October. They are of the *Lensia* type, and the gonophores correspond with one figured by Moser (1925), pl. iv, fig. 11, as *Eudoxia galathea*. As suggested by her on p. 267, the type of loose gonophore figured can hardly be held to belong to the same species as the complete eudoxids bearing that name, for they have a conspicuous rounded mouth-plate and a very narrow apex. This narrowed blind end of the nectosac projects between the two dorsal canals, and is a constant feature of the Barrier Reef specimens. The gonophores are longitudinally folded, but the mouths of the nectosacs flare wide open. The male manubrium may have a length of nearly as much as one-half of that of the whole, but the female is considerably shorter.

4. REFERENCES.

The abbreviations of titles of periodicals are based on the World List (Pollard and Smith, 1927).

AGASSIZ, A., and MAYER, A. G. 1902. Reports on the Scientific Results of the Expedition to the Tropical Pacific . . . 1899 . . . 1900 . . . III. Medusae. Mem. Mus. Comp. Zoöl. Cambridge, Mass. XXVI pp. 139–176, 14 pls.

BEDOT M. 1896. Les Siphonophores de la Baie d'Amboine. Étude suivie d'une revision de la famille des Agalmidae. Rev. suisse Zool. Genève, III, pp. 367–414, pl. xii.

Berrill, N. J. 1930. On the Occurrence and Habits of the Siphonophore, *Stephanomia bijuga* (Delle Chiaje). J. Mar. Biol. Ass. Plymouth, XVI, pp. 753–755, 1 text-fig.

Bigelow, H. B. 1911. Biscayan Plankton Collected during a Cruise of H.M.S. "Research" 1900. Part XIII :—The Siphonophora Trans. Linn. Soc. Zool. London, X, pp. 337–358, pl. xxviii.

—— 1911*b*. The Siphonophorae. Reports Sci. Res. Expedition to the Eastern Tropical Pacific . . . "Albatross" . . . XXIII. Mem. Mus. Comp. Zoöl. Cambridge, Mass. XXXVIII, No. 2, pp. 173–402, 32 pls.

—— 1913. Medusae and Siphonophorae Collected by the U.S. Fisheries Steamer "Albatross" in the North-Western Pacific, 1906. Proc. U.S. Nat. Mus. Washington, XLIV, pp. 1–119, pls. i–vi.

—— 1918. Some Medusae and Siphonophorae from the Western Atlantic. Bull. Mus. Comp. Zoöl. Cambridge, Mass. LXII, pp. 363–442, 8 pls.

—— 1919. Contributions to the Biology of the Philippine Archipelago and adjacent regions : Hydromedusae, Siphonophores and Ctenophores of the "Albatross" Philippine Expedition. Bull. U.S. Nat. Mus. C, I, pp. 279–362, pls. xxxix–xliii.

Blainville, H. M. de. 1830. Zoophytes. Dict. sci. nat. Paris, LX, pp. 1–631, 64 pls.

—— 1834. Manuel d'actinologie ou de zoophytologie. Paris, pp. i–viii + 1–644 + 633–688 + 681–695, Atlas, 100 pls.

Browne, E. T. 1904. Hydromedusae, with a revision of the Williadae and Petasidae. Gardiner, J. S., Fauna and geography of the Maldive and Laccadive Archipelagoes . . . , II, pp. 722–749, pls. liv–lvii.

—— 1926. No. III : Siphonophorae from the Indian Ocean. Trans. Linn. Soc. Zool. London, XIX, 1, pp. 55–86.

Candeias, A. 1929. Note sur quelques siphonophores Calycophorae de Madère. Bull. Soc. portug. Sci. nat. X, pp. 269–284, 12 text-figs.

Chamisso, A. de, and Eysenhardt, C. G. 1821. De animalibus quibusdam e classe vermium Linneana . . . Fasc. II. Nova Acta Leop. Carol. Bonn, X, pp. 343–374, pls. xxiv–xxxiii.

Chun, C. 1886. Über Bau und Entwickelung der Siphonophoren. Dritte Mittheilung. SitzBer. Akad. Wiss. Berlin, XXXVIII, pp. 681–688.

—— 1888. Bericht über eine nach den Canarischen Inseln im Winter 1887/88 ausgeführte Reise. SitzBer. Akad. Wiss. Berlin, XLIV, pp. 1141–1173.

—— 1892. Die Canarischen Siphonophoren in monographischen Darstellungen. II. Die Monophyiden . . . Abh. senckenb. naturf. Ges. XVIII, pp. 57–144, pls. viii–xii.

—— 1897. Die Siphonophoren der Plankton-Expedition. Ergebn. Plankton Exp. II, K.b., 126 pp., 8 pls.

Claus C. 1878. Über Halistemma tergestinum n. sp. nebst Bemerkungen über den feinern Bau der Physophoriden. Arb. Zool. Inst. Wien, I, pp. 1–56, pls. i–v.

Cuvier, G. 1817. Le Règne animal distribué d'après son organisation . . . Paris, IV, pp. viii + 255, 15 pls.

Delle Chiaje, S. 1841. Animali senza vertebre del regno di Napoli. Descrizione e Notomia degli Animali invertebrati della S cilia citeriore . . . . , V, pp. 166, Atlas, Naples.

Eschscholtz, F. 1825. Bericht über die zoologische Ausbeute während der Reise von Kronstadt bis St. Peter und Paul. Oken's Isis, XVI, pp. 733–747, pl. v.

—— 1829. System der Acalephen . . . Berlin, pp. i–vi [printed iv] + 190, 16 pls.

Fewkes, J. W. 1881. Studies of the Jelly-fishes of Narragansett Bay. Bull. Mus. Comp. Zoöl. Cambridge, Mass. VIII, pp. 141–182, 10 pls.

Forskål, P. 1776. Icones rerum naturalium . . . post mortem auctoris . . . edidit Carsten Niebuhr. Hauniae, pp. 15, 43 pls.

Gegenbaur, C. 1853. Beiträge zur näheren Kenntniss der Schwimmpolypen (Siphonophoren). Z. wiss. Zool. Leipzig, V, pp. 285–344, pls. xvi–xviii.

—— 1854. Über Diphyes turgida n. sp., nebst Bemerkungen über Schwimmpolypen. Z. wiss. Zool. Leipzig, V, pp. 442–54, pl. xxiii.

Gravier, C. 1899. Sur un Siphonophore nouveau de la tribu des Prayidae Kölliker. Bull. Mus. Hist. nat. Paris, V, pp. 87–93, 4 text-figs.

Haeckel, E. 1888*a*. System der Siphonophoren . . . Jena. Z. Naturw. XXII, pp. 1–46.

—— 1888*b*. Report on the Siphonophorae. Report Sci. Res. H.M.S. "Challenger" . . . Zoology, XXVIII, viii + iii + 380 pp., 50 pls.

Huxley, T. H. 1859. The Oceanic Hydrozoa . . . Voyage of H.M.S. "Rattlesnake" . . . London Ray Society, pp. x + 143, 12 pls.

HYNDMAN, G. C. 1841. Note on the Occurrence of the Genus Diphya on the coast of Ireland. Ann. Mag. Nat. Hist. VII, pp. 164–166.

LAMARCK, J. B. P. A. de M. de. 1818. Histoire naturelle des animaux sans vertèbres, V, Paris, pp. 612.

LENS, A. D., and VAN RIEMSDIJK, T. 1908. Res. expl. zool. bot. . . . Siboga, IX, pp. 130, 24 pls., 52 text-figs.

LEUCKART, R. 1853. Die Siphonophoren, Giessen, pp. viii + 93, 3 pls.

MAYER, A. G. 1900. Some Medusae from the Tortugas, Florida. Bull. Mus. Comp. Zoöl. Cambridge, Mass. XXXVII, pp. 10–82, 44 pls.

MOSER, F. 1925. Die Siphonophoren der Deutschen Sudpolar Expedition, 1901–3. Deutsche Sudpolar-Expedition 1901–03, Berlin, XVII, Zool. IX, pp. 1–604, pls. i–xxxv.

POLLARD, A. W., and SMITH, W. A. 1927. A World List of Scientific Periodicals Published in the Years 1900–1921 : Vol. II, Abbreviated Titles and Locations of Sets. Oxford Univ. Press, London.

QUOY, J. R. C., and GAIMARD, J. P. 1827. Observations zoologiques faites à bord de l'Astrolabe, en mai 1826, dans le détroit de Gibraltar. Ann. Sci. nat. Paris, X, pp. 1–21, 172–193, Atlas, pls. 1, 2, 4–6.

—— 1828. Abhandlung über die Familie der Diphyden, von Quoy and Gaymard (Annal. des sc. nat. Tom. X, 1827). Oken's Isis, XXI, pp. 330–350, pls. iii–vi.

—— 1833. Voyage de découvertes de l'Astrolabe, . . . de M. J. Dumont D'Urville. Zoologie, IV, pp. 390, Atlas Zoophytes, pls. i–xxvi. Paris.

RUSSELL, F. S., and COLMAN, J. S. 1931. The Zooplankton. I. Gear, Methods and Station Lists. Sci. Reports Great Barrier Reef Expedition, 1928–29. II, No. 2. British Museum (Natural History), London.

SCHNEIDER, K. C. 1896. Mittheilungen über Siphonophoren. II. Grundriss der Organisation der Siphonophoren. Zool. Jahrb. Jena Anat. IX, pp. 571–664, pls. xliii–xlv.

STECHOW, E. 1921. Neue Genera und Species von Hydrozoen und anderen Evertebraten. Arch. Naturgesch. Berlin, A. LXXXVII, pp. 248–265.

VANHÖFFEN, E. 1906. Brandt, K. Nordisches Plankton (V), XI, Siphonophoren, pp. 9–39, 65 text-figs.

VOGT, C. 1854. Recherches sur les animaux inférieures de la Méditerranée. 1. Sur les Siphonophores de la Mer de Nice. Mem. Inst. nat. genev. I, pp. 1–164, 21 pls.

WILL, J. G. F. 1844. Horae Tergestinae . . . der im Herbste 1843 bei Triest beobachten Akalephen. Leipzig, iv + 86 pp., 2 pls.

INDEX

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 11

REPORT ON STOMATOPOD LARVAE, CUMACEA AND CLADOCERA

BY

G. E. H. FOXON, B.A.
(Department of Zoology, University of Glasgow)

WITH TEN TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1932

Price Two Shillings and Sixpence

[*Issued 25th June*, 1932]

ADLARD & SON, LTD. 21 HART STREET, W.C.

Made and printed in Great Britain.

REPORT ON STOMATOPOD LARVAE, CUMACEA AND CLADOCERA

BY

G. E. H. FOXON, B.A.
(Department of Zoology, University of Glasgow)

WITH TEN TEXT-FIGURES

CONTENTS

INTRODUCTION.

The three widely separated groups which form the subject of this report are brought together here as a matter of convenience because each is represented by only a few species.

My thanks are due to Dr. W. T. Calman, F.R.S., of the British Museum, for the opportunity of studying the collections, and also for much helpful advice and encouragement; also to Dr. I. Gordon, of the British Museum, for assistance with the literature of the subject; to Mr. F. S. Russell, who accompanied the Expedition, for information regarding the distribution of the various species in the plankton; and to Mr. F. A. McNeill, of the Australian Museum, who is preparing the report on the adult Stomatopods, for information regarding the distribution of these forms. Finally I must express my thanks to the Director and Trustees of the British Museum for allowing me to carry out the examination of the material in the Museum.

STOMATOPODA.

THE CLASSIFICATION OF STOMATOPOD LARVAE.

The presence in the collection of larvae representative of the majority of the genera of Stomatopoda has rendered possible a consideration of the relations of the generic characters of the larvae to those of the adults. In this connection I have had the opportunity of studying the large collection of larvae in the British Museum.

Our knowledge of the larval Stomatopoda is mainly due to the work of Claus (1872), Brooks (1886), Hansen (1895 and 1926), and Giesbrecht (1910); the last gives a very good account of the earlier work.

The older workers were very impressed by the way in which the *Alima* larvae of *Squilla* differ from the *Erichthus* larvae of the other genera, but Claus (1872) showed that transitional forms occur, and to these he gave the name *Alimerichthus*. Brooks (1886) also held that there was a wide difference between *Alima* and *Erichthus*, and suggested that, when found, the larvae of the new genus *Coronida* would fill the gap (there was then only one species of *Coronida*), but when these larvae were recognized they did not fit into this scheme.

The first attempt to draw up a key to the Stomatopod larvae was made by Bigelow (1895), but unfortunately he based his key on the general appearance of the forms, which is very deceptive, so that it is of little help towards a natural arrangement; moreover he included such groups as *Squillerichthus* and *Alimerichthus*, which, with our present knowledge, cannot be regarded as larval genera.

A great step was made by Hansen (1895), but his methods of identifying the larvae, excellent as they are, result in a misleading arrangement of the genera, with *Alima*, as is usual, separated from the *Erichthus* forms, which then fall into two groups, *Lysiosquilla* and *Coronida* on the one side, and *Gonodactylus*, *Odontodactylus* and *Pseudosquilla* on the other. This arrangement is the result of Hansen's choice of the shape of the three thoracic appendages which follow the raptorial claw* as one of the chief characters.

The relationship of the genera of adult Stomatopoda has always been an intricate problem; an attempt to elucidate the matter was made by Brooks in his "Challenger" report, but later workers have been unable to agree with his conclusions. The introduction of the larval forms into arguments on this subject has, in the past, always resulted in confusing the issue. I have endeavoured to show in a "key" that the larvae fit naturally into such a scheme as is advocated for the adults by Kemp (1913), who says that the genera fall into two groups, with *Squilla*, *Pseudosquilla*, *Lysiosquilla* and *Coronida* on the one hand, and *Gonodactylus* and *Odontodactylus* on the other. This is quite different from the arrangement given above, where *Pseudosquilla* is allied to *Gonodactylus* and *Odontodactylus*.

As regards the course of development, the *Erichthus* larvae are also divided into groups; here again *Pseudosquilla* is brought into proximity with *Gonodactylus* (Calman). The other group is formed by *Lysiosquilla* and *Coronida*, which show a lengthy metamorphosis, involving the transformation of the biramous thoracic appendages into the typical chelate limb.

* Perhaps it is as well to point out here that Hansen, in the "Plankton" report, calls these appendages "Greiffüsse" 1, 2 and 3; in the "Siboga" report he calls them thoracic legs 2, 3 and 4. Calman (1909) calls them thoracic appendages 3, 4 and 5; and it is this last method that I shall adopt here.

It would not appear that the alliance of *Pseudosquilla* with *Gonodactylus* carries any great weight, for, as Calman (1909) has pointed out, *Alima* larvae themselves belong to the same group, that is to say, they hatch at the same stage.* The difference here is really therefore between *Lysiosquilla* and *Coronida* on the one hand, and *all* the other genera on the other. This difference appears to be of little phylogenetic importance, for it is probable that the primitive life-history was like that of a *Lysiosquilla*, and then the provision of more yolk in the egg resulted in the *Squilla* and *Pseudosquilla* type of life-history, where emergence from the egg takes place at a later stage of development, the anterior appendages developing directly and the posterior ones being suppressed; such a condition might have arisen on several independent occasions. The possibility of the genera *Lysiosquilla* and *Coronida* showing a return to the earlier form, by the provision of less yolk in the egg, and thus being revertive rather than primitive, cannot be disregarded.

With regard to the separation of the forms *Alima* and *Erichthus* on morphological grounds, the only constant difference yet recorded is that first noted by Brooks (1886), and quoted both by Giesbrecht (1910) and by Hansen (1926). Brooks pointed out that in *Alima* there are always more than four intermediate denticles between the submedian and lateral denticles of the telson, whilst in the larvae of the other genera (*Erichthus* forms) there is only one such intermediate denticle. It does not seem that this character, which is only regarded as of generic value in the case of the adult *Squilla*, warrants the segregation of the *Alima* and the *Erichthus* forms such as has always taken place in the past.

The key to the genera of the larvae is intended for use with larvae of all stages, and shows the following points:

(1) That the larvae can be classified in the same way as Kemp has suggested for the adults.

(2) That the characters of the larvae bear a very definite relation to those of the adults, the likeness to the adult becoming greater at each successive stage.

(3) That the difference between the *Alima* and the *Erichthus* types is not fundamental as has been supposed, but is really a minor generic modification.

KEY TO THE GENERA OF LARVAL STOMATOPODA.

(1) Larvæ hatch either with biramous thoracic appendages, or with the raptorial claw developed and no appendages on the third, fourth and fifth segments of the thorax. In the raptorial claw the upper margin of the propodus is finely pectinate and the ischio-meral articulation is always terminal.

(*a*) Larvæ hatch with the raptorial claw developed; the so-called "hand" of the fourth thoracic leg is oblong and generally longer than broad, and scarcely bigger than that of the fifth leg.

i. Telson with more than four intermediate denticles between the submedian and lateral denticles . . . . . *Squilla*. [*Alima*.]

ii. Telson with less than four intermediate denticles between the submedian and the lateral denticles . *Pseudosquilla*. [*Pseuderichthus*.]

* It would appear that no Stomatopoda hatch at a stage earlier than the well-known early stages; Lister's so-called metanauplius of a Stomatopod, which has been described and figured in several text-books, has been shown by Gurney (1924) to be a larval decapod.

(*b*) Larvæ hatch with biramous thoracic appendages (*Erichthoidina* stage), which undergo a transformation into the typical chelate form. The "hand" of the fourth thoracic appendage is rounded, often broader than long, and more than twice as big as that of the fifth leg.

i. Propodus of the raptorial claw broad and the dactylus slightly inflated at the base . . . . . . *Coronida*. [*Coroniderichthus*.]

ii. Propodus of the raptorial claw slender and no trace of inflation at the base of the dactylus . . . *Lysiosquilla*. [*Lysioerichthus*.]

(2) Larvæ always hatch with the raptorial claw developed and no appendages on the third, fourth and fifth segments of the thorax. In the raptorial claw the upper margin of the propodus is never pectinate, and in later stages the ischiomeral articulation becomes situated at a point in advance of the proximal end of the merus.

(*a*) The spines of the telson are greatly elongated . *Odontodactylus*. [*Odonterichthus*.]

(*b*) The spines of the telson are not greatly elongated *Gonodactylus*. [*Gonerichthus*.]

THE REFERENCE OF LARVAE TO ADULT FORMS.

The only really sure way of referring a larva to its appropriate adult is by the use of intermediate post-larvae which combine certain characters of the larva with others of the adult; unfortunately post-larvae are entirely lacking in the present collection.

One reference has been attempted, however, by the methods which are discussed by Hansen (1895). More recently Calman (1917) has pointed out that the number of epipodites present on the thoracic appendages varies in the Atlantic species of *Squilla*, and this has provided a useful check on the reference of larvae to the adults.

The following is a list of some species of larvae and adults which have been linked up:

Larva.	Adult.	Epipodites.		Authority.
		Larva.	Adult.	
No larval name	*S. desmaresti*	4	4	Giesbrecht (1910).
,, ,,	*S. mantis*	5	5	,, ,,
,, ,,	*S. empusa*	5	5	Brooks (1879).
A. hyalina	*S. dubia*	4	3	Hansen (1895).

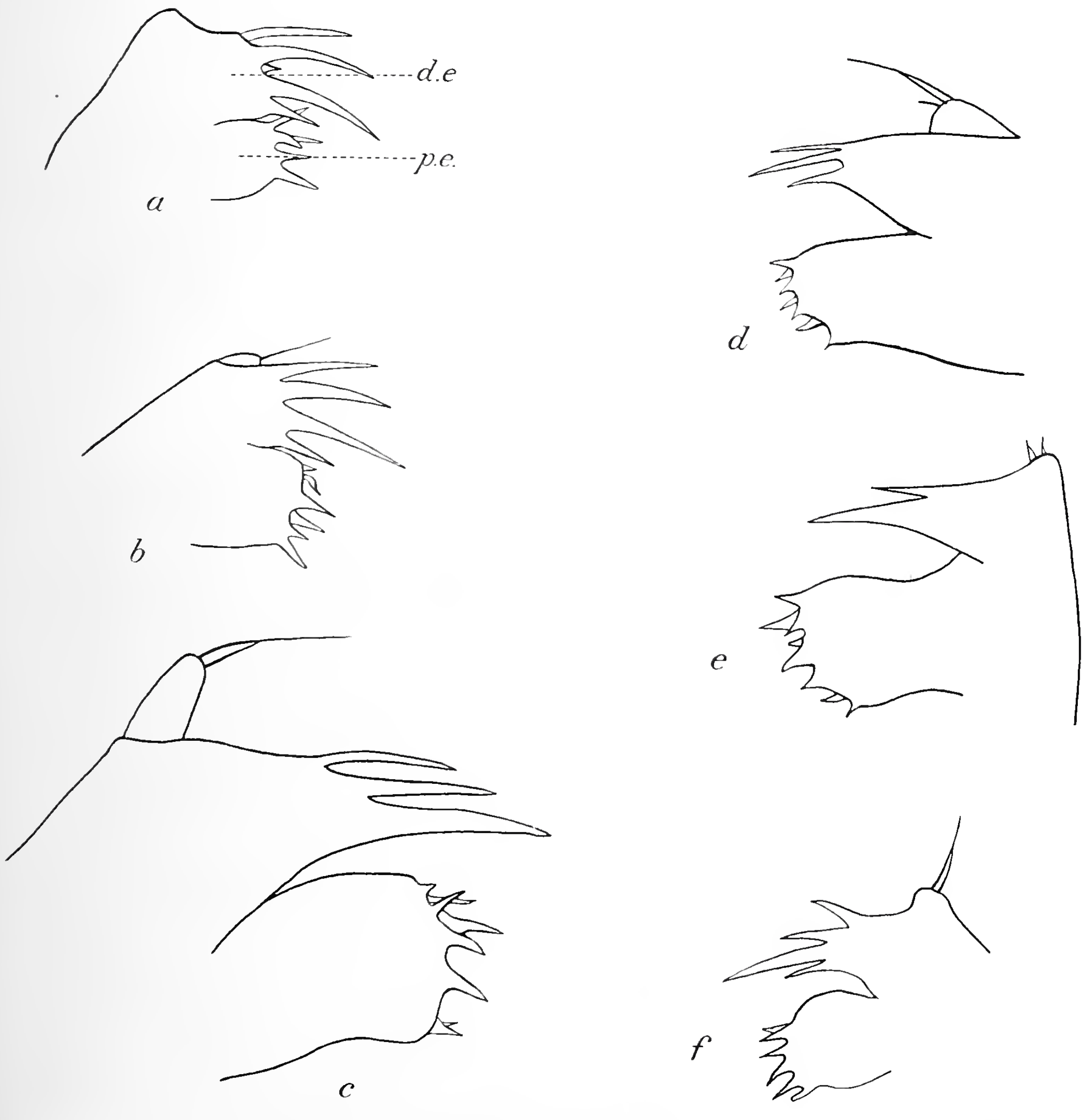
Hansen, who says that *Alima hyalina* is probably the larva of *Squilla dubia*, does so mainly for reasons of geographical distribution, but his suggestion does not appear to be justified by the above evidence. It is not probable that an epipodite would be lost at the post-larval stage, as the general trend in the development of all Stomatopod larvae is towards a gradual assumption of the adult characters.

THE FEEDING MECHANISMS OF THE LARVAE.

The large numbers of individuals of *Lysioerichthus tectus* present in the collection has allowed a study of the mouth-parts and the associated structures to be made; and a comparison of *Lysioerichthus tectus* and *Coroniderichthus rostratus* with representatives of the other genera has demonstrated that the mouth-parts of the larvae show a rather considerable morphological variation, which can be correlated with the methods of feeding and of obtaining food.

Filter-feeding has been stated to occur in the Peracarida, Syncarida and Eucarida and in the larvae of the more primitive Decapods (Cannon and Manton, 1929).

If filter-feeding were to occur in the Stomatopoda it should be looked for in the earliest stages of the larvae of *Lysiosquilla* and *Coronida*, where the raptorial appendages are not



TEXT-FIG. 1.—Maxillules of: *a*, *Lysioerichthus tectus* (M. Edw.), 4-mm. stage; *b*, *Coronid-erichthus rostratus* (Borradaile), 4-mm. stage; *c*, *Lysioerichthus tectus* (M. Edw.), 14-mm. stage; *d*, *Alima emarginata*, Claus, 5-mm. stage; *e*, *Alima emarginata*, Claus, 10-mm. stage; *f*, *Gono-dactylus*, sp., 6-mm. stage. *d.e.*, Distal endite; *p.e.*, proximal endite. All to the same scale.

formed, but an examination of the mouth-parts shows at once that no filter-feeding mechanism can exist, and that the appendages of the thorax are solely natatory in function; it is when the abdomen and its appendages are developed and presumably can take on the swimming function, that the thoracic appendages undergo transformation into the typical chelate form.

The larvae of *Lysiosquilla* and *Coronida*, hatching as they do without raptorial appendages, are clearly at a disadvantage when compared with the larvae of the other genera. A peculiar modification of the maxillule is to be seen in the larvae of these two genera.

Text-fig. 1, *a* shows the maxillule of a 4-mm. *Lysioerichthus tectus*, and it will be noticed that the distal and proximal endites are approximately equal in size; if there is any difference it is that the distal endite is larger than the proximal one, also the proximal endite is not armed with many spines. The same is true of *Coroniderichthus rostratus;* Text-fig. 1, *b* shows a maxillule from a 4-mm. stage.

By the time that the 14-mm. stage is reached in *Lysioerichthus* (see Text-fig. 1, *c*) the proximal endite is becoming more important and is markedly more spinose. On the other hand, at the earliest stage of *Alima emarginata* (Text-fig. 1, *d*), 5 mm. specimen, the proximal endite is already larger than the distal endite and is armed with a considerable number of spines. This difference in size becomes even more pronounced by the time that the 10-mm. stage is reached (Text-fig. 1, *e*); *Gonodactylus* (Text-fig. 1, *f*) and *Pseudosquilla* (see Giesbrecht, 1910) show the same thing.

I wish to suggest, therefore, that in the larvae of *Lysiosquilla* and *Coronida* the maxillule in the earliest stages takes no part in the mastication or maceration of the food, but serves the purpose of holding the food against the mandibles; the elongation of the distal endite of the maxillule appears to be a particular modification for this purpose, whereas in the other genera the grasping function is taken on by the chelate thoracic appendages at a very early stage.

A comparison of the maxillule of *Lysioerichthus tectus* with that of the zoea of *Carcinus maenas* appears to confirm this view. Williamson (1903) gives some figures of the maxillule of the zoea of *Carcinus;* in this case the distal endite retains its dominance over the proximal endite in the later stages of development, but at the same time, in the early stages the distal endites of the maxillules of *Carcinus* and *Lysioerichthus* show a marked resemblance such as might well be concerned with a similarity of function. The feeding mechanism of the zoea of *Carcinus* is, however, known and has been briefly described by Dr. Lebour (1928), who points out that in her experiments no larvae of the Brachyura were reared on a vegetable diet alone, and that "the larvae of oysters and other molluscs, worms and echinoderms are apparently the natural food, and quite small zoeae hāve been seen to eat them, smashing up the mollusc shells and echinoderm spines with their powerful mandibles, whilst holding the food partly with the other mouth-parts and partly with the abdomen curled under the body." It would appear safe to assume that *Lysiosquilla* and *Coronida* larvae use their mouth-parts in a similar manner.

SYSTEMATIC NOTES.

Many of the larvae occurred at most of the stations, so that no station list is given as it would be of little value. Any points of interest in the occurrence or distribution of the species are noted under the species concerned. Mr. Russell's forthcoming paper on the Zooplankton will deal with the quantitative aspect of the distribution and such details are omitted here. The station numbers refer to the list already published (Russell and Colman, 1931).

Squilla, J. C. Fabricius.

1. *Squilla*, sp.

[*Alima emarginata*, Claus.]
[*A. emarginata*, Claus, 1872.]
[*A. emarginata*, Lanchester, 1906.]

Occurrence.—With a few exceptions this species was found regularly at the weekly plankton station; it was also taken at most of the other stations both inside and outside the reef.

Remarks.—Many specimens in all stages of the life-history were taken all the year round, and this points to the species having a prolonged larval life.

Lanchester's figure is hardly typical, especially as regards the telson; and the spinulation of the carapace, of which he gives details, varies greatly, the arrangement as shown by Claus (fig. 33) not being arrived at until a length of 25–30 mm. is reached.

The largest specimen in the collection measures 35 mm. in length including the rostrum, and it closely resembles Claus's figure; it has one less spine showing beneath the skin of the dactylus of the raptorial claw and seven spines on the exopodite of the uropod. Claus's specimen measured 44 mm.

The first four thoracic appendages bear epipodites.

2. *Squilla*, sp.

[*Alima pyramidalis* (Lanchester).]
[*Alimerichthus pyramidalis*, Lanchester, 1903.]
[*Alimerichthus unidens*, Lanchester, 1903.]
[*Alimerichthus a*, Tattersall, 1906.]

Occurrence.—This species was found at the weekly station during the greater part of the year, being taken for the first time on 6th September, 1928, and for the last time on 17th July, 1929; but it was most common from November to June. It was also found at most stations inside the reef but only once outside it, namely station L, outside Papuan Pass.

Remarks.—I am unable to agree with Lanchester and Tattersall that the forms which they describe are really three different species. The characters used by these authors to differentiate the three species resolve themselves into—

(1) The position of the subordinate spines on the carapace,
(2) The spinulation of the telson,
(3) The stage of development reached compared with the length of the specimen.

An examination of the large number of specimens of this type of *Alima* collected by the Expedition shows that all these three characters are subject to a great amount of variation. In the first place, forms which appear to be exactly alike in other respects may have no medio-lateral spine on the carapace, or they may possess one or two such spines. Again the spinulation of the telson varies; Tattersall, in describing *Alimerichthus a*, says that between the submedian and the intermediate spines there are seven intermediate denticles; his figure, however, shows only six such denticles; and in the Barrier Reef material the number of intermediate denticles is seen in some cases to differ on the two sides of the same telson. Then as to comparative size; Lanchester observed that the quite small specimen, which he called *Alimerichthus unidens*, showed the same stage

of development at 12·5 mm. as was shown by *A. pyramidalis* at 17 mm. He noted, too, that *A. unidens* had one fully-developed spine on the dactylus as well as the terminal one. In the Barrier Reef material the degree of the development of the spines on the dactylus appears to be particularly subject to variation; the development of these spines might well depend on a considerable number of factors, both internal and external. Again, with regard to size, Tattersall points out that *Alimerichthus* α is at a later stage at 9 mm. than *A. unidens* at 12 mm. or *A. pyramidalis* at 16 mm., and remarks that it evidently belongs to a smaller species of adult than do the other two species. On the other hand, when describing a form which he calls *Alima* α he says that some forms at 19 mm. are more developed than some at 27 mm., but apparently he is satisfied that the two forms belong to the same species; if this is so, there would appear to be no justification for making *Alimerichthus* α a new species on account of its size.

In support of the view that the Barrier Reef forms all belong to one species, it may be pointed out that in most cases the larvae seemed to be forming homogeneous swarms in the plankton.

The comparatively early assumption of advanced characters by small larvae is typical of the *Alimerichthus* forms, and indeed of *Alima* larvae in general; the prolongation of larval life which appears to have taken place in this genus comes at the end of the larval stage, when many advanced characters have been assumed, not at the beginning.

The largest forms were found in February and March, 1929, when specimens measuring 18 mm. were taken.

3. *Squilla*, sp. (? *lata*, Brooks). (Text-figs. 2 and 3.)

[*Alima*, sp.]

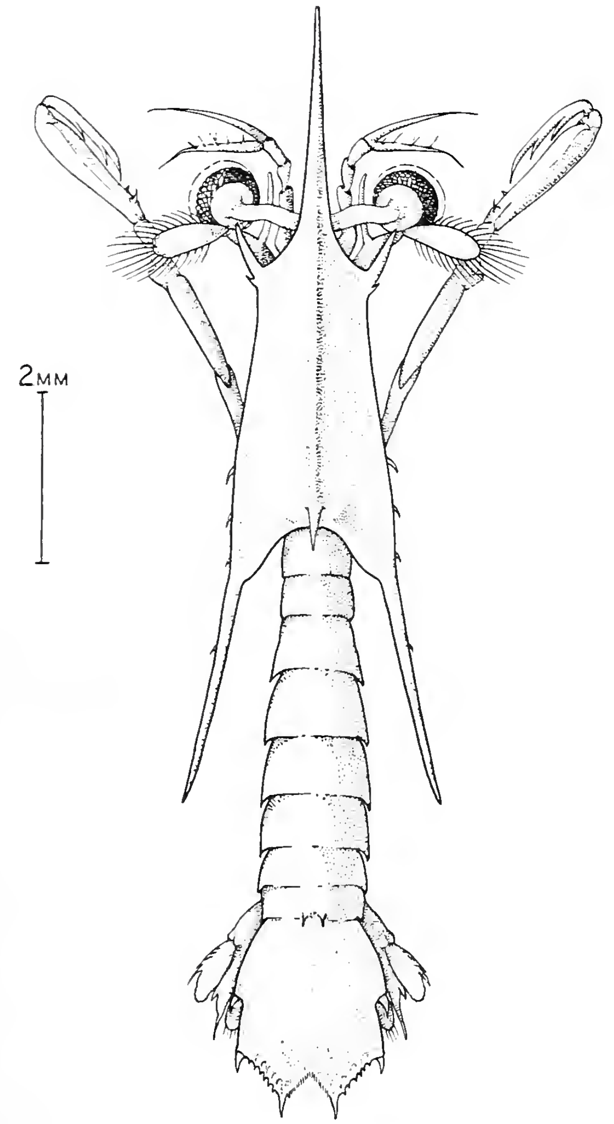
Occurrence.—This species was found at many stations, and nearly all the year round at the weekly station, but it was rare in July, August and September. It was also taken at Stations XLIII, XLIV, XLIX, inside the Reef, and at Station XLV outside it; this species did not occur in Trinity Opening.

Remarks.—This species of *Squilla* larva does not appear to have been described before; as, for reasons given below, it is thought that this form may be the larva of *Squilla lata*, Brooks, a brief description is given.

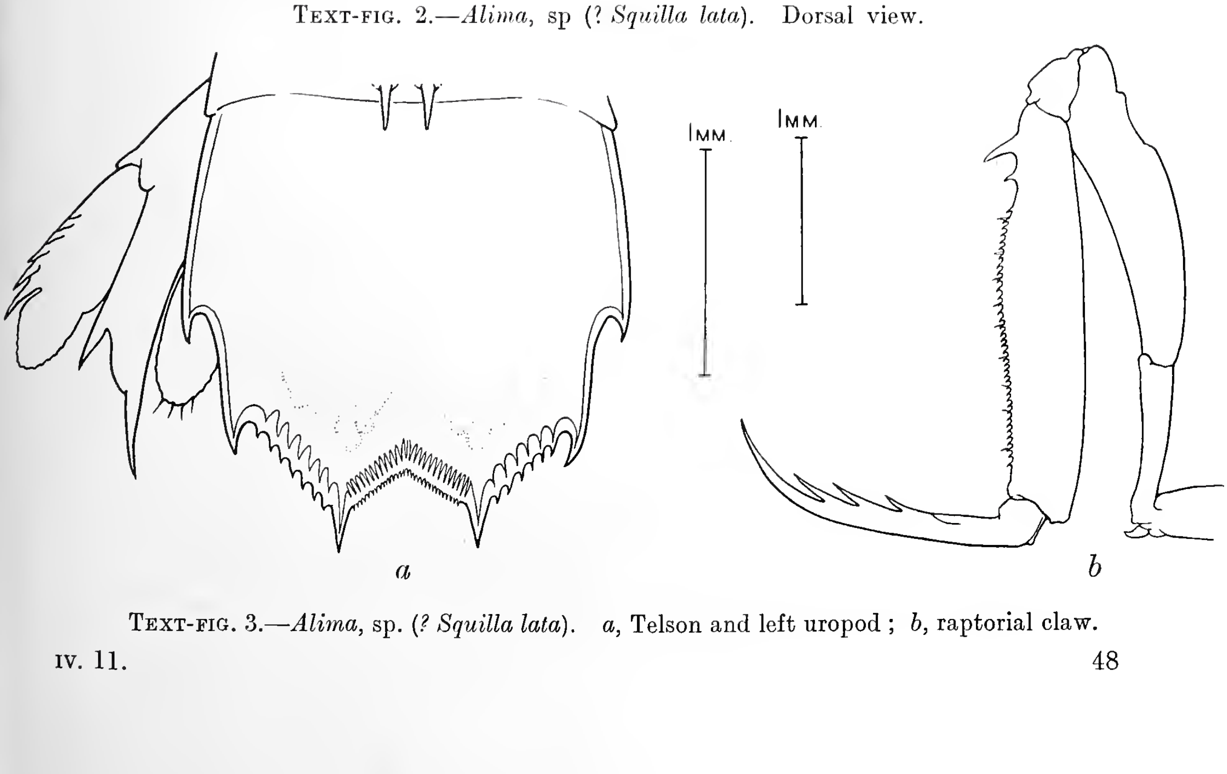
Few of the larvae exceed 16 mm. in length, and at this size appear to be ready for the final moult; the largest specimens are 18 mm. in length.

In general appearance this species resembles *Alima longicaudata*, Jurich (1904).

The carapace, which is three times as long as it is broad, leaves the last three segments of the thorax exposed dorsally. The rostrum is not as long as the antennal flagella, or as long as the posterior lateral spines; ventrally it bears four spines. The anterior lateral spines are short and point forward, each has one ventrally directed spine beneath. The lateral margins of the carapace are armed posteriorly, just in front of the posterior lateral spines, with three ventrally directed spines; the posterior lateral spine itself bears a ventrally directed spine. The "zoea" spine is small, and the carapace only slightly raised near its base. The posterior margin of the carapace is slightly inflected downwards. A dorsal carina, which is not very well marked, traverses the length of the carapace from the rostrum to the "zoea" spine. The only other *Alima* larvae with such carinae are *A. bidens*, Claus, and *Alima* α, of Tattersall.



TEXT-FIG. 2.—*Alima*, sp (? *Squilla lata*). Dorsal view.



TEXT-FIG. 3.—*Alima*, sp. (? *Squilla lata*). *a*, Telson and left uropod ; *b*, raptorial claw.

In a specimen 14 mm. long, four of the thoracic appendages have epipodites, and all the appendages are well developed.

The raptorial claw (Text-fig. 3, *b*) has a rather inflated propodus and a slender dactylus; in well-grown specimens four spines, including the terminal one, are fully-formed, and two more are apparent beneath the skin. A slightly earlier stage is figured.

There are six spines on the exopodite of the uropod (Text-fig. 3, *a*).

The submedian carinae of the abdominal segments end in spines only in the sixth segment.

For the following reasons it is suggested that this larva belongs to *Squilla lata*, Brooks :

(1) Six teeth on the dactylus of the raptorial claw.

(2) Only the submedian carinae of the sixth abdominal segment end in spines.

(3) The similarities seen in the telson and in the uropods.

The only discrepancy between the two is that in the larva there are no serrations on the inner side of the spines of the uropods, such as are present in the adult.

Pseudosquilla, Dana.

4. *Pseudosquilla*, sp.

[*Pseuderichthus affinis*, Borradaile.]
[*Erichthus*, sp., Claus, 1872.]
[*Pseuderichthus affinis*, Borradaile, 1907.]

Occurrence.—This species was present in the plankton in small numbers only. At the weekly station it was found at intervals throughout the year, but was absent from February to June. Other localities were Stations VIII, XI, XLIV, XLIX, all inside the reef. On 16th November, 1928, specimens were taken in the tow-nets in the Low Isles Anchorage.

Remarks.—Although Borradaile assigns this species to the genus *Pseuderichthus* with a query, his determination appears to be correct.

The largest specimens are somewhat more advanced than that figured by Claus (fig. 33) ; his specimen was 8 mm. long ; the Barrier Reef examples are 10 mm. in length.

The uropods are, in this stage, as long as the telson and the spines of the uropods somewhat longer than this. The five thoracic appendages are well developed and the last three are just becoming biramous. There is no trace of any spines on the dactylus of the raptorial claw and its merus is somewhat inflated. The pectination of the propodus is very conspicuous.

Lysiosquilla, Dana.

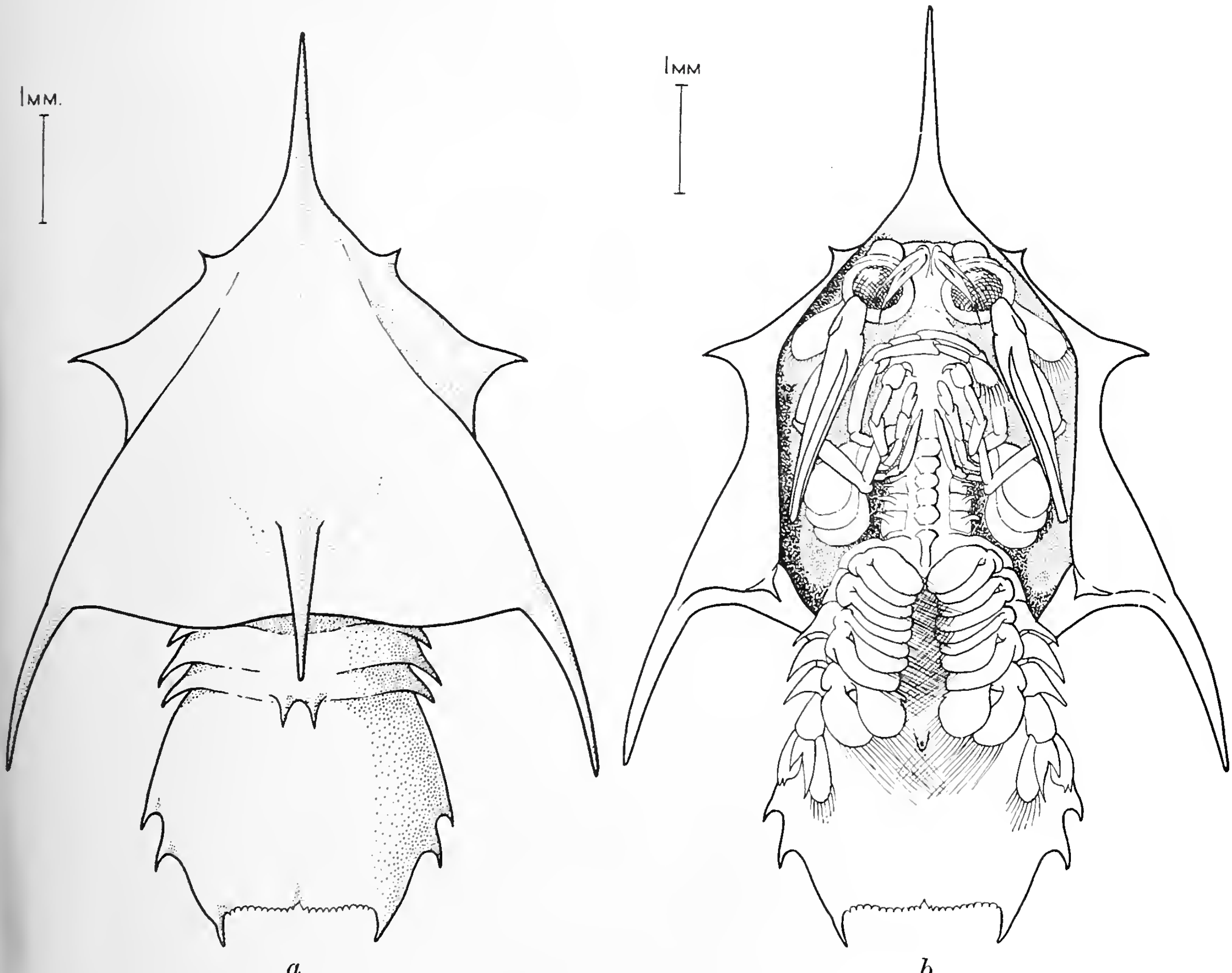
5. *Lysiosquilla*, sp. (Text-fig. 4.)

[*Lysioerichthus tectus* (M. Edw.).]
[*Erichthus tectus*, Milne Edwards, 1837.]
[*Erichthus tectus*, Dana, 1852.]

Occurrence.—This form occurred for a short time during the year, and was taken at the weekly station from 21st November, 1928, until 18th February, 1929 (Stations XXVII, XXX, XXXIII–XLII inclusive). It was not found at any other locality.

Remarks.—This species does not appear to have been found since it was first described by Milne Edwards, who gives a brief description of this form and says that

it is very like *Erichthus triangularis*, M. Edw., from which it is differentiated by the possession of a medio-lateral spine on the carapace. Unfortunately he does not figure this species, but Claus (1872) gives good figures of *E. triangularis*, M. Edw. (not *E. triangularis*, Brooks), and there is little room for doubt in the determination of this



TEXT-FIG. 4.—*Lysioerichthus tectus* (M. Edw.). *a*, Dorsal view; *b*, ventral view.

species. As this species has not been figured before, figures of both dorsal and ventral views are given.

The great size of the carapace is most striking. In the largest specimen, of which the total length is 15 mm., there are no traces of teeth on the dactylus. All the *Lysiosquilla* larvae which were collected belong to this species, and it is peculiar that the larvae of *Lysiosquilla maculata* were not found.

A very large number of forms in all stages were taken, and they have formed the basis of the notes on the mouth-parts made above.

Coronida, Brooks.

6. *Coronida*, sp.

[*Coroniderichthus rostratus* (Borradaile).]
[*Erichthus*, sp., Claus, 1872.]
[*Erichthus* (? *Odonterichthus*) *rostratus*, Borradaile, 1907.]

Occurrence.—This species was first found at Station VIII (Trinity Opening). Afterwards it occurred at the weekly station (Stations XIV, XXII, XXIII, XXXIV, XLII, LII), and also at Stations XLIII, XLVI, and XLIX, all inside the reef. On 18th October, 1928, this species was taken in the Low Isles Anchorage plankton.

Remarks.—The specimens collected by the Expedition are undoubtedly *Coroniderichthi.* They are identical with both the figures given by Claus and with the actual specimens collected by the "Sea-Lark" Expedition.

The pectination of the merus of the raptorial claw and the shape of the third, fourth and fifth thoracic appendages preclude the possibility of these forms belonging to an *Odontodactylus*, and the inflated propodus and rather swollen dactylus of the raptorial claw show that it does not belong to a *Lysiosquilla.*

The specimens are nearly all small, the largest being between 10 mm. and 12 mm.

Gonodactylus, Latreille.

7. *Gonodactylus*, sp.

[*Gonerichthus*, sp.]

Occurrence.—This species did not occur on many occasions. It was taken occasionally at the weekly station from August, 1928, until January, 1929 (Stations V, VII, XXI, XXII, XXXVI, XXXIX). Other localities were: Trinity Opening (Stations VIII and XI), inside Papuan Pass (Station XLIX). It was not found outside the reef.

Remarks.—The specimens of *Gonerichthus* larvae all belong to one species, and as *Gonodactylus chiragra* is so common on the reef it is highly probable that they are the larvae of this form. Of the forms previously described this species is most like that shown by Brooks (1886), pl. xii, fig. 5. The greatest point of similarity is that there is no "zoea" spine. Although Brooks's form came from the Atlantic, he states that a similar form was found in the Celebes sea, and of this he figures the telson. The suggestion that these two forms belong to the same species seems hardly feasible, as no one species of *Gonodactylus* occurs in both the Atlantic and the Pacific. The telson of the Barrier Reef specimen is very similar to that of the one from the Celebes sea, and these two specimens probably belong to the same species.

If these forms are the larvae of *G. chiragra,* it may be that the Atlantic form described by Brooks is the larva of *G. Oerstedii,* Hansen.

The largest specimen is 15 mm. in length. There is no "zoea" spine. The rostrum has six spines on the ventral surface. There are a few spines (not pectination) on the proximal part of the propodus of the raptorial claw; the dactylus is very slender. The outer spine of the uropod is much elongated, the inner almost suppressed. The uropod is not as long as the telson; the telson is slightly longer than broad; the spines of the telson are as long as those shown in *Odonterichthus tenuicornis,* Jurich (1904, pl. xxviii,

fig. 4), or even a little longer ; this would appear to be contradictory to what is stated in the key, but Hansen (1926) expresses himself doubtful as to the correctness of Jurich's determination of the genus, so that this point has been disregarded.

CUMACEA.

INTRODUCTION.

The collection of Cumacea is small, but nevertheless provides material of interest. It has been possible to name seven species, and two others appear to be represented ; three of the determinable species are regarded as new. Owing to the specimens having been preserved in formalin they have suffered to a large extent from decalcification; several are so damaged that identification is impossible, and it is probable that when further material becomes available, the descriptions of the new species may require revision, at least as far as the carapace is concerned.

The small size of the collection is largely due to the infrequency with which plankton collections were made at night. Only on one occasion were Cumacea found during the day, and that was at Station XXIX, where they were taken in the bottom stramin net.

The Cumacea previously known from Australian waters were reviewed by Hale in 1928, and it is significant that not one of the species recorded by him was found by the Expedition. This is no doubt due to the fact that the Eastern coast of the Continent seems to have been left untouched by previous collectors. It appears that the Barrier Reef Cumacean fauna bears some affinity to that of New Zealand on the one hand, and to the more northern fauna on the other ; for *Cyclaspis levis* and *Cyclaspis similis*, hitherto known from New Zealand, were both found by the Expedition. *Nannastacus suhmii*, which was also taken, was previously known from the Philippine Islands ; and it is noted later that certain species of the genus *Cyclaspis*, which it has not been possible to name, bear affinities to species of that genus previously recorded from North-Western Australia.

There is a very apparent difference between the Cumacean fauna of the Lagoon and that of the deeper waters outside it. At Stations XXI and XXIX *Sympodomma australiensis* and *Campylaspis pileus* both occurred, no other species being taken. In the Lagoon, on the other hand, neither of these species was taken on any occasion, although several species were taken more than once.

LIST OF STATIONS AT WHICH CUMACEA WERE OBTAINED.

Date.	Station.	Time.	Net.	Depth.
1.x.28	Low Isles Anchorage	Night	Medium	Surface.
22.x.28	XXI	8.40–9.10 p.m.	Stramin	22 m.*
16.xi.28	Low Isles Anchorage	7.30 p.m.	Coarse	Surface.
24.xi.28	XXIX	2.17 p.m.	B.S.N.	200 m.
29.xi.28	Low Isles Anchorage	Moonlight	Coarse	Surface.
28.vi.29	,, ,,	Night	Medium	,,

* This is the fishing depth. For details of all Plankton Stations outside the Lagoon Russell and Colman (1931) should be consulted.

SYSTEMATIC NOTES.

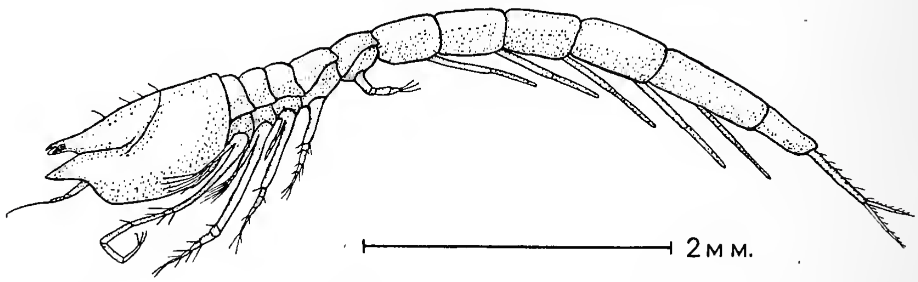
Sympodommatidae.

Sympodomma, Stebbing.

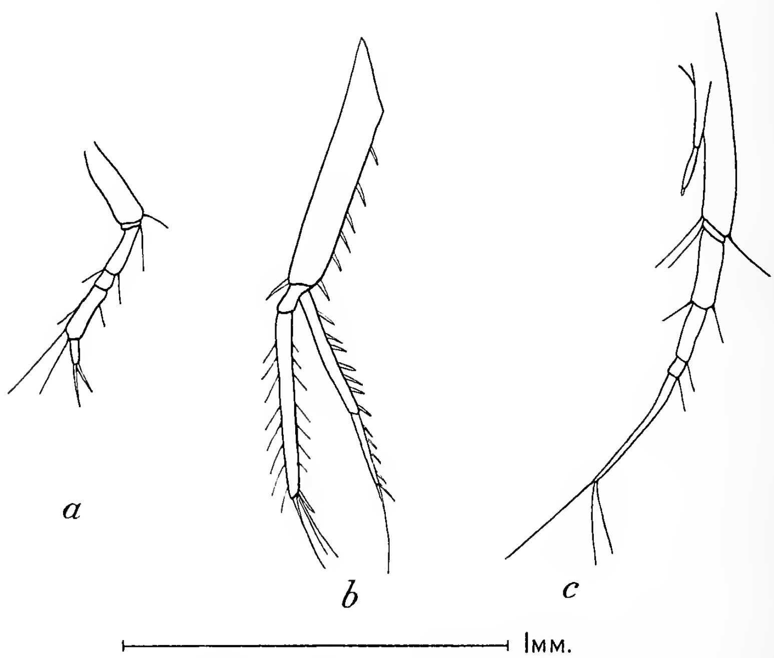
8. *Sympodomma australiensis*, n. sp. (Text-figs. 5 and 6.)

Occurrence.—Stations XXI and XXIX.

Description of a Female 7 mm. in Length.—The body is slender and the uropods are elongated.



Text-fig. 5.—*Sympodomma australiensis*, n. sp. Male. Lateral view.



Text-fig. 6.—*Sympodomma australiensis*, n. sp. *a*, Fifth leg of male ; *b*, uropod of male ; *c*, second leg of male.

The carapace (Text-fig. 5) is one-fifth of the total length. It has a marked dorsal ridge, which terminates anteriorly in a sharp tooth over the typical elongated ocular lobe, and the ridge is armed by a few hairs and three or four small denticles, not projections of the carapace, as in *Sympodomma africana*, Stebbing. An antennal notch is present. From the pseudorostral lobes slight keels extend obliquely upwards to the middle crest, which they meet in its middle point. A pigmented eye is present at the extremity of the ocular lobe.

The thorax is slightly longer than the carapace, the cephalothorax forming one-third of the total length. The first leg-bearing segment is very narrow dorsally, the fourth segment is the largest. The three posterior segments of the thorax are as slender as those of the abdomen.

The abdomen is long and slender, and forms two-thirds of the total length. The fifth segment is the longest.

In the uropods (Text-fig. 6, *b*) the peduncle is as long as the telsonic segment. The exopod is slightly shorter than the endopod; the endopod is equal in length to the peduncle. The first joint of the exopod is one-fifth the length of the second joint. The rami and the peduncle are armed with sharp spines, those of the exopod are not, however, as strong as those borne by the endopod and the peduncle.

The first legs are one and a half times the length of the carapace. The basis is four-fifths the length of all the remaining joints together. The ischium is small; the merus and carpus are subequal; the carpus is two-thirds the length of the propodus; the dactylus is four-fifths the length of the propodus.

In the second legs (Text-fig. 6, *c*) the basis is, comparatively, slightly longer than in the first legs; the ischium is reduced to a chitinous ring, the propodus is quite small, the merus and carpus are subequal, and the dactylus is nearly as long as the merus and carpus together. In the third to fifth legs (Text-fig. 6, *a*) the ischium is small but quite distinct.

Remarks.—The males appear to be mature when 8 mm. in length. The pleopods are very long.

This species appears to resemble *Sympodomma weberi* (Calman), but it is much smaller. The two species agree in having no prominent teeth on the dorsal crest of the carapace, but on the other hand, the telsonic segment in *S. australiensis* is triangularly produced between the bases of the uropods, which is not so in *S. weberi*. Also in *S. australiensis* there is only one corneal area with a light pigmentation, whereas *S. weberi* has two distinct corneal areas. The antennal notch is more pronounced than in *S. weberi*.

Bodotriidae.

Cyclaspis, G. O. Sars.

The members of this genus have suffered greatly from the method of preservation, and the sculpturing of the carapace can only be made out with great difficulty, and in some cases not at all. In addition to the species described below there are members of at least two other species in the collection; unfortunately, owing to the state of preservation, it is useless to attempt to describe them. One of them is interesting, as it shows on the first dorsally visible thoracic segment a crest of hairs, similar to those which have been described by Zimmer (1921 *b*) in *Cyclaspis mjöbergi*, Zimmer, *C. supersculpta*, Zimmer, and *C. candida*, Zimmer, all of which come from North-Western Australian waters.

9. *Cyclaspis levis*, G. M. Thomson.

C. levis, G. M. Thomson, 1892; Stebbing, 1913; Calman, 1917.

Occurrence.—29th November, 1928, and 28th June, 1929, Low Isles Anchorage.

Remarks.—Although the two specimens are smaller than those previously described I do not hesitate to assign them to this species.

They are not well preserved, but it is possible to make out the dorsal keel on the otherwise smooth carapace, the proportions of both the parts of the body and of the joints of the limbs are the same as in the specimens previously described.

The long apical seta on the basis of the first leg is very conspicuous; the proportions of the uropods are typical, and their armature is nearly typical, but the hairs on the endopod are comparatively few.

10. *Cyclaspis similis*, Calman.

C. similis, Calman, 1907; Stebbing, 1913; Calman, 1917.

Occurrence.—16th November, 1928, Low Isles Anchorage.

Remarks.—One male and one female were taken. They are both smaller than the specimens of this species previously described. They are not well preserved, but show the chief characters of the species.

Diastylidae.

Dimorphostylis, Zimmer.

11. *Dimorphostylis australis*, n. sp. (Text-figs. 7 and 8.)

Occurrence.—1st October, 1928, 16th November, 1928, and 28th June, 1929, Low Isles Anchorage.

Description of Female 5 mm. in Length.—The carapace (Text-fig. 7, *a* and *b*) forms one-fourth of the total length; it is broader than deep, and has the dorsal surface well arched. The pseudorostrum is small and not very acute. There is a well-marked eye, behind which there is a small flattened area of the carapace, which bears four tubercles; posterior to this the carapace is well rounded and the crest slopes down to the hinder margin. The sides of the carapace are ornamented with two parallel lateral keels; these are not continuous over the crest, but terminate a little distance on either side. The antennal notch is nearly obliterated.

In the thorax there are five free segments, which together are slightly shorter than the carapace; of these the fourth is the largest.

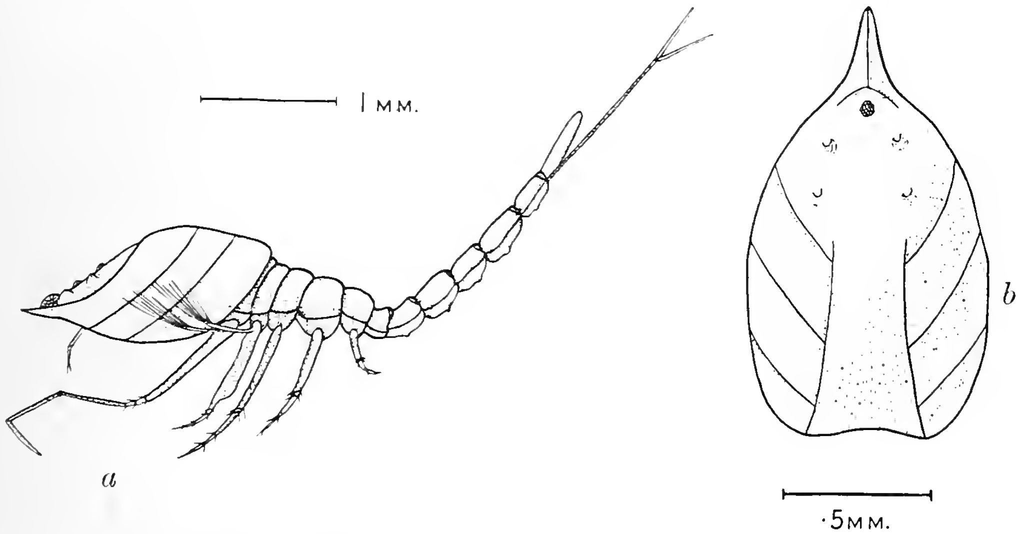
The abdomen is more slender than the cephalothoracic region. The segments of the abdomen are armed ventrally with spines. In the males very strong spines are borne on the third and fourth abdominal segments in a position corresponding to that in which the pleopods are found in the preceding segments.

The telson (Text-fig. 8, *b*) is longer than any segment of the abdomen, but it is only two-thirds the length of the peduncle of the uropods. The anus opens at the distal end of the telson and its opening is guarded by two distinct valves. In the male two distinct post-anal spines are conspicuous. I think that it is highly probable that these spines also occur in the females, but this is not obvious in any of the specimens in the collection.

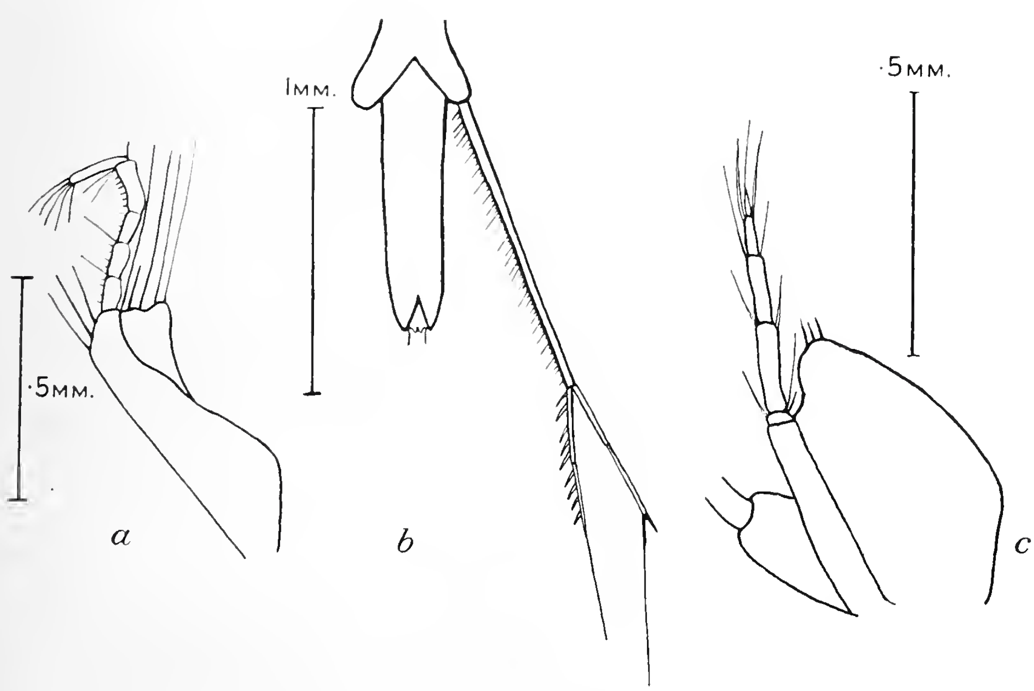
The uropods (Text-fig. 8, *b*) are greatly elongated, being much longer than the telson; the basal joint is armed with spines. The endopod is nearly as long as the exopod. The two basal joints of the endopod are armed with spines; the exopod is unarmed.

The antennule is as long as the carapace; the first segment of the peduncle is larger than either of the two segments. The outer flagellum is longer than the peduncle; the inner much shorter than the outer.

The first legs are less than twice as long as the carapace; the dactylus is less than twice the length of the propodus; the carpus and propodus are subequal.



TEXT-FIG. 7.—*Dimorphostylis australis*, n. sp. *a*, Lateral view of female; *b*, carapace, dorsal view.



TEXT-FIG. 8.—*Dimorphostylis australis*, n. sp. *a*, Third maxilliped of male; *b*, telson and uropod of male, ventral view; *c*, third leg of male.

In the second leg the exopod and endopod are subequal. The second leg is much shorter than the first.

The third (Text-fig. 8, *c*) and fourth legs are slightly longer than the second leg.

The thoracic legs show in a very marked way the lamellar expansion of the basis characteristic of the genus. The basis is produced on the inner side as a large leaf-like expansion which is turned forwards ; terminally it is produced so that it extends further than the distal end of the ischium.

Remarks.—This species is placed in the genus *Dimorphostylis*, founded by Zimmer (1921 *a*) for the reception of a species called *D. asiatica*, Zimmer ; this is done for the following reasons :

(1) The similarity in the sculpturing of the carapace in the two species.
(2) The shape of the basis in the thoracic legs.
(3) The similarity exhibited by the uropods.
(4) The similarity that exists between the structure of the telson of the female of *D. asiatica* and the telson of both sexes of *D. australis*.

The main difference between the two species is to be found in the telson of the males. Whereas in *Dimorphostylis australis* there is apparently little difference between the telson in the two sexes, in *D. asiatica* there is a great difference, the male possessing quite a large post-anal portion which is absent in the female. It should be pointed out that, although the telson of *D. australis* is very like that of the female of *D. asiatica*, it is much longer and bears approximately the same relation in proportion to the uropods as does that of the male in *D. asiatica*.

It appears, therefore, that the marked sexual dimorphism, which is one of the most marked characters of *Dimorphostylis asiatica*, and indeed the character which gave the name to the genus, is not a noticeable character of *D. australis*—a form that has to be placed in this genus for other reasons.

Nannastacidae.

Nannastacus, Bate.

12. *Nannastacus suhmii*, G. O. Sars.

N. suhmii, G. O. Sars, 1886.
N. suhmii, Stebbing, 1913.
N. suhmi, Zimmer, 1921 *a*.

Occurrence.—1st October, 1928, and 29th November, 1928, Low Isles Anchorage.

Remarks.—Only males were taken ; their average length is 2·3 mm. Although the specimens are poorly preserved I do not doubt that they belong to this species. The only member of this genus previously described from Australian waters is *N. nasutus*, Zimmer (1914), and this record is from South Australia ; *N. nasutus* and *N. suhmii* are very dissimilar.

In his description of the male of *Nannastacus suhmii*, Sars states that the flagellum of the second antenna does not extend further backward than the third segment of the abdomen. The Barrier Reef specimens have this flagellum extending as far as the last abdominal segment. I have re-examined the "Challenger" type-specimens which have been dismounted by Dr. Calman (see Calman, 1905), and it is quite clear that the antennal flagella do extend the whole length of the abdomen ; the same is the case in the specimens of the "Siboga" Expedition referred to this species by Dr. Calman (*loc. cit.*).

Cumella, G. O. Sars.

13. *Cumella*. sp.

Occurrence.—28th June, 1929, Low Isles Anchorage.

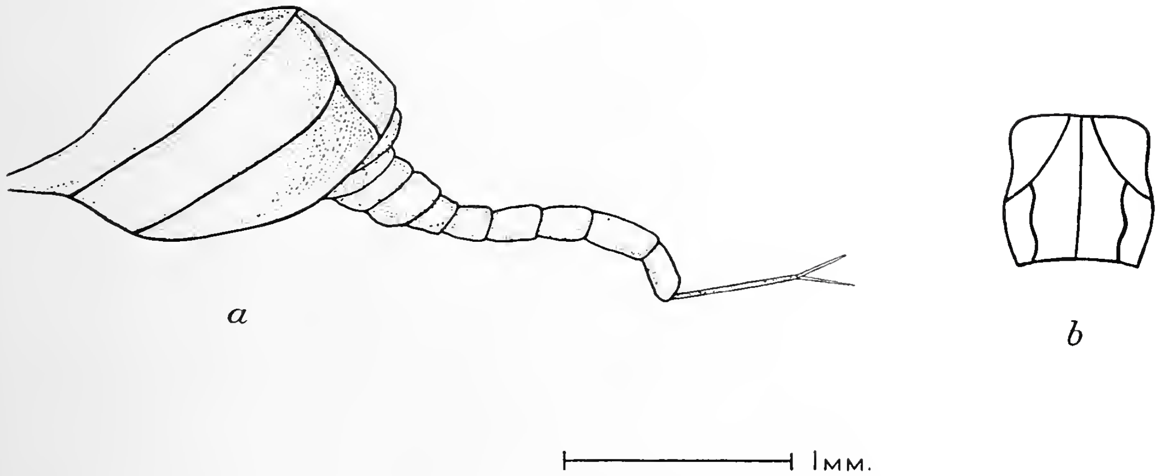
Remarks.—In general appearance this species resembles *Cumella cyclaspoides*, Zimmer (1914), but the uropods are distinctly longer.

I have not attempted to describe this species as no female specimens are present in the collection, and in the light of Dr. Calman's remarks (1911) little purpose would be served by a description based on the male forms only.

Campylaspididae.

Campylaspis, G. O. Sars.

14. *Campylaspis pileus*, n.sp. (Text-figs. 9 and 10.)

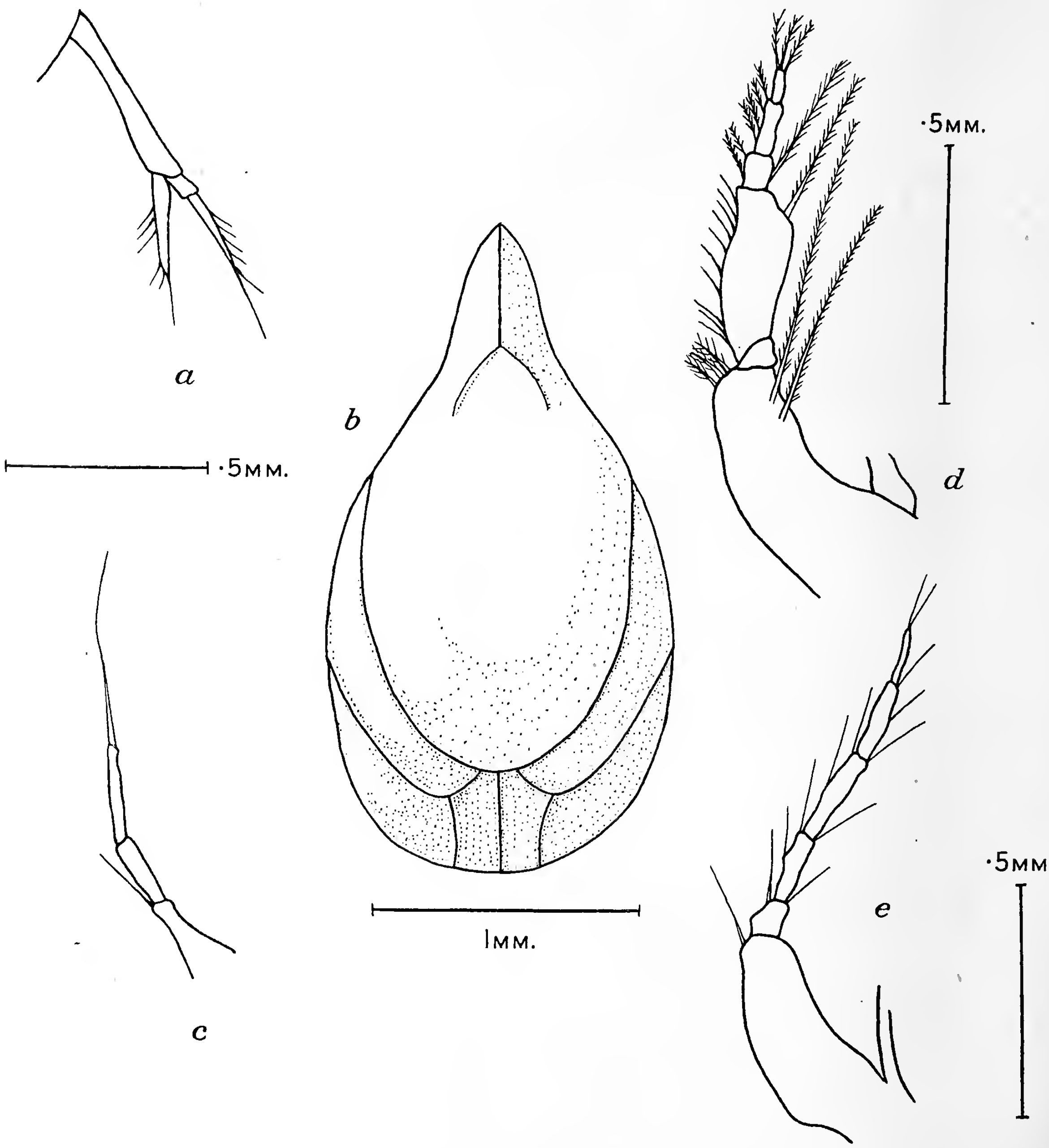


Text-fig. 9.—*Campylaspis pileus*, n. sp. *a*, Lateral view of female, the appendages omitted; *b*, the carapace from the rear.

Occurrence.—Stations XXI and XXIX.

Description of a Female 3·5 mm. in Length.—The carapace (Text-figs. 9, *b*, and 10, *c*) is a little less than half the total length; it is very broad, and dorsally it has a large flattened area marked off by a strong keel, which extends round the carapace from below the pseudorostral lobe on one side to a similar position on the other. Externally to this first keel the carapace inclines sharply downwards, so that the sides of the carapace are nearly at right-angles to the dorsal surface. Half-way between the first keel and the margin of the carapace there is a second keel; laterally it is parallel to the first keel, but posteriorly it turns upwards and meets the first keel quite close to the middle line. On each side of the carapace a third keel extends from the middle of the curve of the second keel to the posterior edge of the carapace. In the middle of the approximately triangular area of the carapace produced on the posterior surface by the intersections of these keels, a fourth keel extends from the most posterior point of the first keel to the hinder margin of the carapace. The fourth keel is not as well defined as are the others.

The pseudorostral lobes are very large, and project far in advance of the ocular lobe. There is no distinct eye and no pigment is present. The integument of the carapace is roughly pitted, but except for the keels there is no marked sculpturing.



TEXT-FIG. 10.—*Campylaspis pileus*, n. sp. *a*, Uropod of female ; *b*, carapace, dorsal view ; *c*, first antenna of female ; *d*, third maxilliped of female ; *e*, first leg of female.

The thorax is quite small and slender; all the leg-bearing segments are free, but dorsally they are obscured by the large posterior extension of the carapace.

The abdomen is very slender, the fifth segment being the longest and the pentagonal sixth segment the shortest.

In the Uropods (Text-fig. 10, *a*) the peduncle is twice as long as the sixth segment of the abdomen; the subequal rami are three-fourths the length of the peduncle. The uropods are armed with a few stout spines; there are five on the endopod, four on the exopod and seven smaller spines on the peduncle, but these numbers appear to be subject to variation.

The antennule (Text-fig. 10, *c*) has the accessory flagellum very small.

In the first leg (Text-fig. 10, *e*) the basis is three-fourths the length of the remaining joints; the ischium is small, being half the length of the merus; the carpus is one-fourth longer than the merus. The merus and propodus are equal in length, and the dactylus is equal to two-thirds the length of the propodus. There are many hairs on each segment of the limb.

Remarks.—This species bears certain resemblances to *Campylaspis vitrea*, Calman (1906), but the carapace is not so highly vaulted in *C. pileus* as it is in *C. vitrea*, though there is a general similarity in the arrangement of the keels. There is also some resemblance between *C. pileus* and *C. ovalis*, Stebbing (1912), but they differ in that the greatest breadth of the carapace in *C. ovalis* is in the anterior portion whilst in *C. pileus* it is two-thirds of the way back, being well inside the posterior half of the carapace when viewed dorsally.

CLADOCERA.

The Cladocera are represented in the collections by one species only, and specimens only occurred for a short time during the year.

15. *Evadne tergestina*, Claus.

E. tergestina, Claus, 1877.
E. aspinosa, Krämer, 1895.
E. gibsoni, Brady, 1914.

Occurrence.—This species occurred at the weekly station during December, 1928, and January and February of 1929 (Stations XXXII—XLII inclusive). It was not taken at any other locality.

Remarks.—Several of the specimens tend to confirm Dr. Calman's opinion that *E. gibsoni*, Brady, is synonymous with this species, as they show a deep cervical groove such as Brady described. In all cases this appeared to be due to uneven contraction of the body away from the carapace. The best figures of this species are those given by Krämer under the synonym of *E. aspinosa*.

Previous records for this species are: N. Atlantic and Mediterranean (Hansen, 1899), S. Atlantic (Calman, 1917; Hansen, *loc. cit.*), Californian Coast (Juday, 1907), Indian Ocean (Hansen, *loc. cit.*), Australian waters (Hansen, *loc. cit.*; Krämer, 1895), New Zealand (Krämer, *loc. cit.*), and S. Africa (Brady, 1914).

REFERENCES.

Bigelow, R. P. 1895. Report on the Crustacea of the Order Stomatopoda collected by the Steamer "Albatross" between 1885 and 1891, and on Other Specimens in the U.S. National Museum. Proc. U.S. Nat. Mus. XVII, pp. 489–550, pls. xx–xxii, text-figs. 1–28.

Borradaile, L. A. 1907. Stomatopoda from the West Indian Ocean. Trans. Linn. Soc. Lond. 2nd ser. Zoology, XII, pp. 209–216, pl. xxii.

BRADY, G. S. 1914. On Some Pelagic Entomostraca Collected by Mr. J. Y. Gibson in Durban Bay. Ann. Durban Mus. I, pp. 1–9, pls. i–iv.

BROOKS, W. K. 1879. The Larval Stages of *Squilla empusa*, Say. Johns Hopkins Univ. Baltimore. Chesapeake Zool. Lab. Scientific Results 1878, pp. 143–170, pls. ix–xiii.

—— 1886. Report on the Stomatopoda Collected by H.M.S. " Challenger " during the years 1873–1876. " Challenger " Reports, Zoology, XVI, pp. 116, pls. i–xvi.

CALMAN, W. T. 1905. The Cumacea of the " Siboga " Expedition. Siboga-Expeditie. Monographie, XXXVI, pp. 23, pls. i, ii, text-figs. 1–4.

—— 1906. The Cumacea of the " Puritan " Expedition. Mitt. zool. Stat. Neapel, XVII, pp. 411–432, pls. xxvii, xxviii.

—— 1907. On New or Rare Crustacea of the Order Cumacea from the Collection ot the Copenhagen Museum. Part I : The Families Bodotriidae, Vauntompsoniidae and Leuconidae. Trans. Zool. Soc. Lond. XVIII, pp. 1–58, pls. i–ix.

—— 1909. A Treatise on Zoology. Edited by Sir E. Ray Lankester. Part VII : Appendiculata. Fascicle 3 : The Crustacea, pp. viii, 346, text illustrated.

—— 1911. On New or Rare Crustacea of the Order Cumacea from the Collection of the Copenhagen Museum. Part II : The Families Nannastacidae and Diastylidae. Trans. Zool. Soc. Lond. XVIII, pp. 341–398, pls. xxxii–xxxvii.

—— 1917. British Antarctic " Terra Nova " Expedition, 1910. Zoology, III, Crustacea. Part IV : Stomatopoda, Cumacea, Phyllocarida and Cladocera, pp. 137–162, text-figs. 1–9.

CANNON, H. G., and MANTON, S. M. 1929. On the Feeding Mechanism of the Syncarid Crustacea. Trans. Roy. Soc. Edinb. LVI, pp. 175–189, text-figs. 1–8.

CLAUS, C. 1872. Die Metamorphose der Squilliden. Abh. Ges. Wiss. Göttingen, XVI, pp. 111–163, pls. i–viii.

—— 1877. Zur Kenntniss des Baues und der Organisation der Polyphemiden. Denkschr. Akad. Wiss. Wien. Math.-Nat. Cl. XXXVII, pp. 137–160, pls. i–vii.

DANA, J. D. 1852. United States Exploring Expedition during 1838–1842 under the command of Charles Wilkes. XIII, Crustacea, Part I, 1852, and Atlas, 1855.

EDWARDS, H. MILNE. 1837. Histoire Naturelle des Crustacés. Paris, II, and Atlas.

GIESBRECHT, W. 1910. Fauna und Flora des Golfes von Neapel. Monographie, XXXIII, Stomatopoden, pp. vii, 239, pls. i–xi, text-figs. 1–12.

GURNEY, R. 1924. British Antarctic " Terra Nova " Expedition, 1910. Zoology, VIII, No. 2, Crustacea. Part IX : Decapod Larvae, pp. 37–202, text-figs. 1–78.

HALE, H. M. 1928. Australian Cumacea. Trans. Proc. Roy. Soc. S. Aust. LII, 1928, pp. 31–48, text-figs. 1–17.

HANSEN, H. J. 1895. Isopoden, Cumaceen und Stomatopoden der Plankton Expedition. Ergebn. d Plankton-Expedition, II, G.c., pp. 105, pls. i–viii.

—— 1899. Die Cladoceren und Cirripedien der Plankton-Expedition. Ergebn. d. Plankton-Expedition, II, G.d., pp. 58, pls. i–iii, 1 chart.

—— 1926. The Stomatopoda of the " Siboga " Expedition. Siboga-Expeditie. Monographie, XXXV, pp. 48, pls. i, ii.

JUDAY, C. 1907. Cladocera of the San Diego Region. Univ. Calif. Pub. Zool. III, pp. 157–158, text-fig. 1.

JURICH, B. 1904. Die Stomatopoden der deutschen Tiefsee-Expedition. Wiss. Ergebn. d. deutschen Tiefsee-Expedition. " Valdivia," VII, pp. 361–408, pls. xxv–xxx.

KEMP, S. 1913. An Account of the Crustacea Stomatopoda of the Indo-Pacific Region. Mem. Ind. Mus. IV, pp. 217, pls. i–x.

KRÄMER, A. 1895. On the Most Frequent Pelagic Copepods and Cladoceres of the Hauraki Gulf. Trans. N.Z. Inst. XXVII, pp. 214–223, pls. xv–xxiii.

LANCHESTER, W. F. 1903. Marine Crustaceans. VIII : Stomatopoda. In Fauna and Geography of the Maldive and Laccadive Archipelagoes. Edited by J. S. Gardiner. I, pp. 444–459, pl. xxiii.

—— 1906. Report on the Crustacea. Fasciculi Malayenses. Edited by N. Annandale and C. Robinson. Pt. III, pp. 127–134, pl. i.

LEBOUR, M. V. 1928. The Larval Stages of the Plymouth Brachyura. Proc. Zool. Soc. Lond. 1928, pp. 473–560, pls. i–xvi, text-figs. 1–5.

RUSSELL, F. S., and COLMAN, J. S. 1931. Great Barrier Reef Expedition, 1928–29, Scientific Reports, II, No. 2, The Zooplankton. 1 : Gear, Methods and Station Lists, pp. 35, pl. i, text-figs. 1–9.

SARS, G. O. 1886. Report on the Cumacea collected by H.M.S. " Challenger " during the years 1873–1876. " Challenger " Reports, Zoology, XIX, part LV, pp. 78, pls. i–xi.

Stebbing, T. R. R. 1912. South African Crustacea. Part VI: The Sympoda. Ann. S. Afr. Mus. X, pp. 129–176, pls. i–xvi, 2 text-figs.

—— 1913. Cumacea. In Das Tierreich. Lief. XXXIX, pp. xvi, 210, text-figs. 1–137.

Tattersall, W. M. 1906. Report on the Leptostraca, Schizopoda and Stomatopoda. Report on the Pearl Oyster Fisheries of the Gulf of Manaar, Part V, by W. A. Herdman, pp. 157–188, pls. i–iii.

Thomson, G. M. 1892. On the Occurrence of Two Species of Cumacea in New Zealand. J. Linn. Soc. Lond. (Zool.), XXIV, pp. 263–271, pls. xvi–xviii.

Williamson, H. C. 1903. On the Larval and Early Young Stages and Rate of Growth of the Shore-crab (*Carcinus maenas*, Leach). Rep. Fish. B. Scot. XXI, Part III, pp. 136–179, pls. vii–xiii.

Zimmer, C. 1914. Die Fauna Südwest-Australiens. Ergebn. der Hamburger südwest-australischen Forschungsreise 1905. Herausgegeben von W. Michaelsen und R. Hartmeyer, V, pp. 175–195, text-figs. 1–18.

—— 1921 *a*. Mitteilung über Cumaceen des Berliner Zoologischen Museums. Mitt. Zool. Mus. Berlin, X, pp. 115–149. text-figs. 1–55.

—— 1921 *b*. Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910–1913. XXVI: Cumaceen. K. Svenska VetenskAkad. Handl. LXI, No. 7, pp. 13, text-figs. 1–16.

INDEX

(The principal references are in heavy type.)

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 12

THE POLYZOA
WITH A NOTE ON AN ASSOCIATED HYDROID

BY

ANNA B. HASTINGS, M.A., PH.D.
Assistant Keeper in the Department of Zoology

WITH TWENTY TEXT-FIGURES AND ONE PLATE

LONDON
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1932

Price Five Shillings

[*Issued 23rd July, 1932*]

Made and printed in Great Britain

THE POLYZOA
WITH A NOTE ON AN ASSOCIATED HYDROID

BY

ANNA B. HASTINGS, M.A., Ph.D.
Assistant Keeper in the Department of Zoology

WITH TWENTY TEXT-FIGURES AND ONE PLATE

INTRODUCTION.

As might be expected, this collection shows a close relationship between the Polyzoan fauna of the Great Barrier Reef and that of the Malayan region. Among the Entoprocta and the Ectoprocta, with the exception of the Ascophora, only two species (*Loxocalyx*, sp., and *Nolella alta*) have not been recorded from Malaya, and the latter is now known from China. Probably, when an account of the Ascophora of the "Siboga" Expedition is available, as close a relationship will be found there too. As will be seen from the list of species (p. 400), the collection adds considerably to the number of species known to occur on the reef.

Mr. A. A. Livingstone, of the Australian Museum, joined the expedition on Low Isles for the months of October and November, 1928. He collected ten species of Polyzoa, including one new species of *Petralia*. On his return he prepared a report on them and sent the specimens to the British Museum, keeping a duplicate series. Subsequently hearing that the collection made by the other members of the expedition was to be described by me, he suggested that it was undesirable to publish two reports, and, sending me his MS., gave me a free hand to use it in preparing my paper and to describe his new species. For this I offer him my sincere thanks.

I am also indebted to the Manchester Museum for lending me specimens from the Waters Collection, to the Cambridge Museum for a loan of specimens, and to Sir Sidney Harmer, K.B.E., F.R.S., for much very valuable help.

COLLECTING STATIONS.

Polyzoa were very scarce on the shore. Some colonies of *Retepora graeffei* developed on a box sunk in the shallow water of the Anchorage at Low Isles, and Mr. Livingstone's collection includes seven species, which he collected on the shore at Low Isles and Batt Reef.

The rest of the collection was obtained by dredge or trawl. The particulars of the six unnumbered stations from which Polyzoa were obtained and the abbreviated titles by which they are distinguished in this report are as follows:

N.E. Low Is.: September, 1928, off N.E. Low Isles, 8 fath., mud, dredge.
N.W. Low Is.: 5.ix.28, off N.W. Low Isles, 9 fath., mud, dredge.
Low Is., 12 fath.: 16.x.28, off Low Isles, 12 fath., dredge.
Off N. Anchorage: 17.x.28, off N. Anchorage, Low Isles, 9 fath., sand, coral fragments, Agassiz trawl.
W. Low Is., 6 fath.: W. of Low Isles, about 6 fath., mixed bottom.
W. Low Is., 8 fath.: 15.xi.28, W. of Low Isles, 8 fath., mud.

Polyzoa were obtained from the following numbered stations:

II. 24.xi.28. Linden Bank, 28 fath., shell and sand, dredge 10 min. and 5 min.
VIII. 21.ii.29. $1\frac{1}{2}$ miles N.W. Low Isles, 11 fath., mud, Agassiz trawl, 30 min.
IX. 22.ii.29. Penguin Channel, 12–14 fath., clean pit with mud at sides, 6 dredges about 20 min. each.
XII. 24.ii.29. Penguin Channel, 10–$15\frac{1}{2}$ fath., rock and shell gravel, mud on edges of pit, 5 dredges about 30 min. each.
XIII. 7.iii.29. $\frac{1}{2}$ mile W. of Two Isles, $16\frac{1}{2}$ fath., hard, 2 dredges, 20 min. each.
XIV. 7.iii.29. $\frac{1}{2}$ mile S.E. of Lizard Is., 19 fath., shell gravel, rich *Halimeda*, 3 dredges, 20–30 min. each.
XXI. 11.iii.29. $\frac{1}{2}$ mile N.W. Howick Is., 10 fath., mud and shell, Foraminifera, 2 dredges, 30 and 40 min.
XXII. 11.iii.29. To East of Snake Reef, $13\frac{1}{2}$ fath., mud with Foraminifera and shells, 2 dredges $\frac{1}{2}$ hour each.
XXIV. 13.iii.29. $\frac{3}{4}$ mile N.E. Pasco Reef, $16\frac{1}{2}$ fath., hard shell bottom.

LIST OF SPECIES IN THE COLLECTION.

ENTOPROCTA.

**Barentsia gracilis* (Sars).
**Pedicellina compacta*, Harm.
**Loxosoma circulare*, Harm.
**L. pusillum*, Harm.
**L. breve*, Harm.
Loxocalyx, sp.

ECTOPROCTA.

Cyclostomata.

Crisia elongata, M.-E.
Mesonea radians (Lmk.).
Tubulipora pulcherrima (Kirkp.).

Ctenostomata.

Amathia convoluta, Lmx.
**Nolella alta* (Kirkp.).
**Valkeria atlantica* (Busk).
Buskia setigera, Hcks.

Cheilostomata anasca.

**Aetea anguina* (L.).
**A. truncata* (Landsb.).
**Synnotum aegyptiacum* (Aud.).
**Caulibugula dendrograpta* (Waters).
**Beania regularis*, Thorn.
Nellia oculata, Busk.
**Didymozoum triseriale* (Phil.).
Retiflustra cornea (Busk).
**Scrupocellaria maderensis*, Busk.
S. diadema, Busk.
S. delilii (Aud.).
**S. spatulata* (d'Orb.).
Caberea lata, Busk.
**C. boryi* (Aud.).
**C. transversa*, Harm.
Acanthodesia savartii (Aud.).
Chaperia acanthina (Lmx.).
Setosellina coronata (Hcks.).
Cupuladria guineensis (Busk).

CHEILOSTOMATA ANASCA—*continued.*

Steganoporella buskii, Harm.
Thalamoporella rozieri (Aud.).
Cellaria punctata (Busk).

CHEILOSTOMATA ASCOPHORA.

Hippopodina feegeensis (Busk).
Lepralia montferrandii (Aud.).
**Schizomavella lata* (MacG.).
S. australis (Hasw.).
Emballotheca, sp.
**Stylopoma schizostoma* (MacG.).
**S. viride* (Thorn.).
**Hippothoa distans*, MacG.
Mastigophora pesanseris (Smitt).
**Trypostega venusta* (Norm.).
**Microporella ciliata* (Pall.).
M. malusii (Aud.).
M. mutabilis, sp. n.
**Smittina signata* (Waters).
**S. obstructa* (Waters).

CHEILOSTOMATA ASCOPHORA—*continued.*

**S. acaroensis*, Levins.
**Phylactella geometrica*, Kirkp.
Ciglisula areolata, Kirkp.
**C. cautium*, sp. n.
Petralia chuakensis, Waters.
P. vultur var. *serrata*, Living.
**P. litoralis*, Living. MS., sp. n.
Rhynchozoon longirostre (Hcks.).
Retepora graeffei (Kirch.).
R. monilifera var. *munita*, Hcks.
**R. monilifera*, var. *benemunita* (Busk MS.), var. n.
R. tubulata, Busk.
**Holoporella mamillata* (Busk).
H. fusca (Busk).
**H. intermedia* (MacG.).
H. tridenticulata (Busk).
**Catenaria lafontii* (Aud.).
Vittaticella elegans (Busk).

The species marked with an asterisk are additions to the lists of Queensland Polyzoa published by Livingstone (1926, 1927). Some of them have, however, been recorded from Torres Straits by Busk and Kirkpatrick, and *Barentsia gracilis* was recorded from Queensland by Waters.

ENTOPROCTA.

The number of clearly distinguished species of Australian Entoprocta is small, and it may be useful to give a list with references to the Australian records :

Pedicellina whiteleggii, Johnston and Walker, 1917, p. 60, = *P. cernua*, Whitelegge, 1889, p. 293.

Pedicellina cernua, Pallas, Kirkpatrick, 1888*b*, p. 21. This specimen from Port Phillip (B.M. 88.5.17.24) consists of three small individuals with short, much contracted stalks. In the characters by which *P. whiteleggii* is supposed to be distinguished from *P. cernua* it resembles the latter, having long spines, which are absent from the distal extremity of the stalk and from the calyx and are not conspicuously swollen at the base.

Pedicellinopsis fruticosa, Hincks, 1884*a*, p. 364. Johnston and Walker (1917, p. 62) give a list of subsequent records of this species.

Barentsia gracilis, Sars, Kirkpatrick, 1888*b*, p. 21 (see below, p. 402).

Barentsia laxa, Kirkpatrick, 1890*a*, p. 624.

In addition there are seven records of unnamed *Loxosoma* and two of *Pedicellina.* The latter were found by Goldstein (1880, p. 44) on *Retepora* and by Macgillivray (1887*b*, p. 221), both on the coasts of Victoria.

Two species of *Loxosoma* were found at Shark's Bay, W. Australia, by Macdonald (1877, p. 211), who took them to be spermatophores of the leeches to which they were attached. Goddard (1910, p. 725) rediscovered one of them, but apparently the calyx is deciduous, and with only the stalk known, the form remains undefined. Macdonald's figures would not be recognized even as representing Entoprocta.

Whitelegge (1889, p. 293) records a *Loxosoma* on the Sipunculid, *Phascolosoma australe*, but without description, and the form has not been rediscovered.

Haswell (1892, p. 330) found a *Loxosoma* on the long setae of the Polychaet *Coppingeria longisetosa*, Haswell, at Port Molle, but did not describe it. His figure (pl. xxvi, fig. 1) gives the appearance of the whole worm with the *Loxosoma* attached. I have found specimens in the same position on the same species of worm from the type-locality (B.M. 32.2.1.1) which may be assumed to be Haswell's species. It is near to *L. sluiteri*, Harmer (1915, p. 9), with which it agrees in size and general shape, in the number of tentacles, and in the absence of lateral lobes to the stomach and of cirri and lateral expansions on the calyx. It differs in not having the rather conspicuous cuticle of *L. sluiteri*. Buds are not common, but specimens with one or occasionally two have been seen. The vestibule frequently contains two embryos.

Waters (1904, p. 100) mentions, without description, a *Loxosoma* from Lizard Island, Queensland. The Manchester Museum has kindly lent me the slides of these specimens, showing four whole individuals and one in section attached to a plant stem. The species agrees with *L. circulare*, Harmer (1915, p. 16), in the stomach, gonads, embryos and buds and in the shape of the calyx. Its tentacles cannot be counted. Its average dimensions are: width calyx 218μ, length calyx 305μ, length stalk 305μ. It is thus larger than typical *L. circulare*. The dimensions of the larger "Siboga" specimens (358B) tentatively referred to that species lie between the extremes found in those from Lizard Island.

Finally there is the species from Port Phillip found by Harmer (1915, p. 5) on *Amathia wilsoni*. The smallest specimen measured agrees in size with the largest Barrier Reef *Loxocalyx*, but most are larger, being a little larger than *Loxosoma crassicauda*, Kirkpatrick (discussed below under *Loxocalyx*, sp.). The species on *Amathia* resembles that species in its thick stalk with longitudinal fibres and large cells, but the tentacles are more numerous, probably about 14, and no external sense-organs can be detected.

There are six species of Entoprocta in the Barrier Reef collection. The well-known *Barentsia gracilis* needs no further mention. The small size and wide difference of host of the other five makes it unlikely that they are identical with any of those dismissed above as unrecognizable, and none of them can be related to any of the unnamed Australian forms of which I have examined specimens, unless, when the range of variation of *Loxosoma circulare* is better known, Waters's *Loxosoma* from Queensland should prove to belong to that species.

Barentsia gracilis (Sars).

Pedicellina gracilis, Sars, 1835, p. 6, pl. i, figs. 2*a*, *b*.
Barentsia gracilis, Waters, 1904, p. 100; Ritchie, 1911, p. 840, pl. xlvii, figs. 5–7 (synonymy); Harmer, 1915, p. 27, pl. ii, fig. 12 (references); Annandale, 1922, p. 150; Hastings, 1927, p. 351.

Occurrence.—N.E. Low Is.; St. II, IX.

Distribution.—Queensland, New Zealand, Malaya, India, Red Sea, Mediterranean, Europe, N. Atlantic, Arctic.

Ehlers (1890, p. 143) thought that the description of *Ascopodaria gracilis* by Kirkpatrick (1888*b*, p. 21) might refer to *P. fruticosa*, Hincks, and not to *P. gracilis*, Sars. The only special resemblance to *P. fruticosa* mentioned by Kirkpatrick is the pointed end to the chitinous part of the stalk. As noticed by Harmer (1915, p. 28, footnote), this cannot be seen in Kirkpatrick's specimens. In some individuals the chitinous part does end abruptly at a little distance from the calyx, but the opening is not oblique. In

its very much smaller size and finer stolon and the absence of pores in the cuticle of the stalk, Kirkpatrick's specimens resemble *B. gracilis* and are unmistakably distinct from *P. fruticosa.*

Pedicellina compacta, Harmer.

Pedicellina compacta, Harmer, 1915, p. 24, pl. ii, figs. 13, 14.

Occurence.—St. XII on *Caberea boryi.*

Distribution.—Aru Islands.

This specimen consists of one small individual and two buds connected to it by stolons, but the agreement with Harmer's description and paratype specimen leaves no doubt of their identity. The specimen is immature. Its dimensions are less than those given for adult individuals, but many of the younger individuals on the paratype slide are the same size. The rectum is recumbent. The calyx bears a number of short filamentous processes. At least four were detected in rolling the specimen over before mounting. Similar processes can be seen on the paratypes.

Loxosoma circulare, Harmer.

Loxosoma circulare, Harmer, 1915, p. 16, pl. i, figs. 14–16.

Occurrence.—St. II on *Retepora monilifera* var. *munita.*

Distribution.—Malaya.

Only a few specimens of this *Loxosoma* have been found in the Barrier Reef Collections, and it has not been possible to count their tentacles. There are certainly not more than 12. In size and shape the animals agree very closely with the type, but the calyx may be a little narrower. There may be two or three pairs of tactile processes and, as in some of the type-specimens, these spring from a narrow expansion of the body-wall, suggestive of that of *L. velatum*, Harmer, but much narrower and not continued on the stalk. The stalk bears a few irregularly distributed lateral processes (*cf.* Harmer, fig. 14). No individual has been seen with more than one bud. The structure of the genital organs cannot be made out.

Although some characters are uncertain, and others are not in complete agreement with those of *L. circulare*, I think the agreement is sufficiently close to justify the identification of the Barrier Reef specimens with that species.

As explained above (p. 402), the *Loxosoma* from Queensland mentioned by Waters (1904, p. 100) is closely allied to *L. circulare.*

Loxosoma pusillum, Harmer.

Loxosoma pusillum, Harmer, 1915, p. 16, pl. i, figs. 19, 20.

Occurrence.—St. II on *Retepora monilifera* var. *benemunita.*

Distribution.—Malaya.

Loxosoma breve, Harmer.

Loxosoma breve, Harmer, 1915, p. 19, pl. i, figs. 29–31.

Occurrence.—St. XXVIII on *Schizomavella australis.*

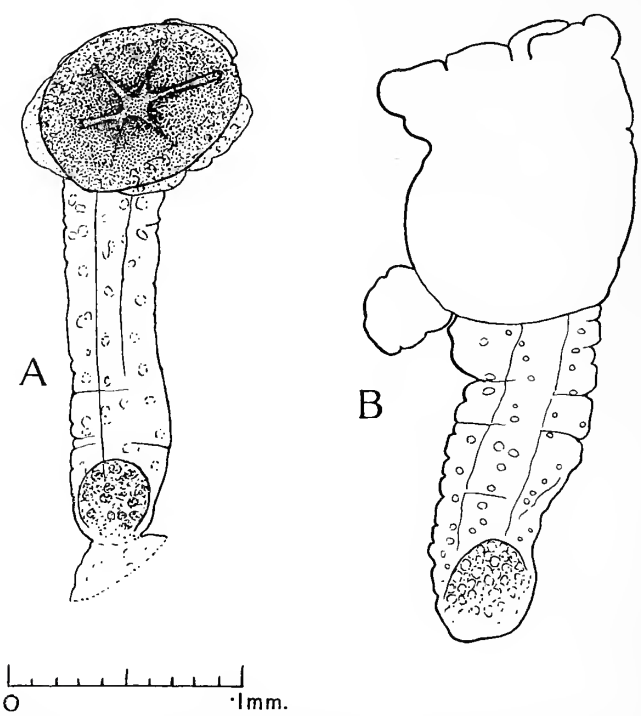
Distribution.—New Guinea.

A single individual of this species was attached to the outer surface of the operculum of its host, with its oral surface directed towards the opening of the compensation sac, *i. e.* proximally.

Loxocalyx, sp. (Text-fig. 1.)

Occurrence.—W. Low Is., 8 fath., on the Polychaet *Sthenelais malayana*, Horst (Monro, 1931, p. 8).

Description.—The calyx is, on the average, ·14 mm. long and ·09 mm. wide. The stalk is very little narrower than the calyx, and in its somewhat contracted condition, usually about the same length. The calyx of the largest specimen is ·20 × ·14 mm. The lophophore is only slightly oblique (Text-fig. 1, B), and bears, where it has been possible to count them accurately, 6 stout tentacles (Text-fig. 1, A). No external sensory processes have been seen. The anal papilla bears a tuft of long cilia and frequently projects beyond the inturned tentacles. The stalk has a few longitudinal fibres, and between them single



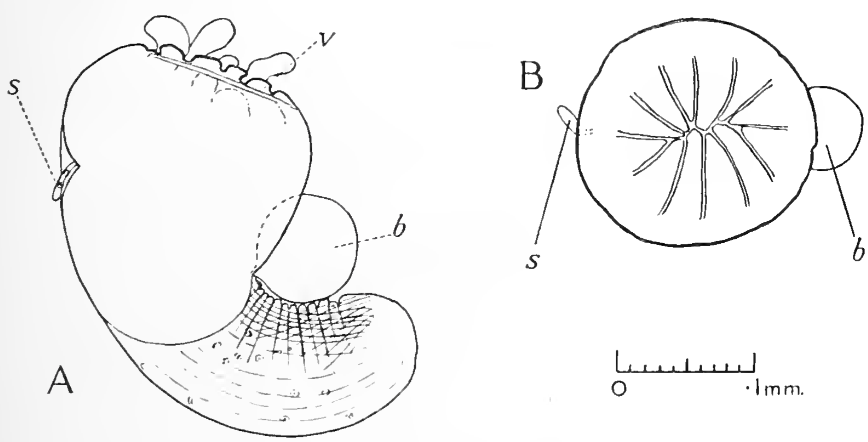
Text-fig. 1.—*Loxocalyx*, sp. Left side. A, With the calyx bent at right angles to the stalk, showing tentacles. B, Unbent, foot incomplete.

rows of large, unevenly-spaced cells. The foot-gland is more or less spherical and below it the stalk contracts and then spreads out to a disc-like foot, without wings (Text-fig. 1, A).

Remarks.—The presence of a foot-gland puts this species in *Loxocalyx*, although the duct has not been detected and the foot is not alate. Harmer (1915, p. 7) gives a list of the species of *Loxocalyx*, six being Neapolitan, one Malayan and one common to these two localities. The Barrier Reef specimens differ from all of them in their small size, in the small number of their tentacles, and in the very slight obliquity of the lophophore. The possibility must not be overlooked, however, that they are immature. The genital organs have not been observed, and the buds are at a very early stage of development. If so the animals might be expected to increase in size, and perhaps form more tentacles, and it is possible that the lophophore might become more oblique. *L. lineatus*, Harmer (1915, p. 6), which is the nearest *Loxocalyx* geographically, has a long slender stalk, and differs in the shape of the foot and in having membranous expansions on the calyx. It

thus seems probable that the Barrier Reef specimens represent a new species, but while the possibility remains that they are juvenile specimens, I prefer not to give them a name.

The specimens from the Tizard Bank (B.M. 89.8.21.70), tentatively identified by Kirkpatrick (1890*b*, p. 17) with *Loxosoma crassicauda*, Salensky (1877, p. 2), have been remounted, and show some resemblance to the Barrier Reef specimens in their general shape (Text-fig. 2, A), and in the structure of the stalk, which is thick, and has longitudinal muscles and large cells in between, but the longitudinal bands are more numerous, and no foot-glands can be detected. Three of the specimens are larger than the Barrier Reef *Loxocalyx;* the fourth has almost exactly the average dimensions of that form. They appear to have more tentacles, though not as many as *L. crassicauda*, Salensky. They cannot be counted with any certainty. Remounting has disclosed the presence of a characteristic organ, presumably a sense-organ. It takes the form of a slender, clavate



TEXT-FIG. 2.—*Loxosoma crassicauda*, Kirkpatrick (*non* Salensky). A, One of Kirkpatrick's specimens. B, Distal view of a specimen from Tahiti. *b.*, Bud. *s.*, Sense organ. *v.*, Velum.

streamer of protoplasm containing one or two nuclei (Text-fig. 2A). One of these processes can be seen in each specimen. The edge of the velum is lobed. Better preserved material, which I believe to belong to this species, is growing on a shell collected by Dr. Crossland in Papeete Harbour, Tahiti (B.M. 29.4.25.5). There are twelve tentacles and a single, sensory process on the anal radius (Text-fig. 2, B). Owing to the smaller number of tentacles, the structure of the sense-organ and the rather less oblique lophopore, *L. crassicauda*, Kirkpatrick, must probably be distinguished from *L. crassicauda*, Salensky.

ECTOPROCTA.

Crisia elongata, Milne-Edwards.

Crisia elongata, Milne-Edwards, 1838, p. 203, pl. vii, fig. 2; Harmer, 1915, p. 96, pl. viii, figs. 1–8 (synonymy); Marcus, 1921*a*, p. 29; 1921*b*, p. 19; O'Donoghue, 1924, p. 24; Livingstone, 1927, p. 67.

OCCURRENCE.—N.E. Low Is.; off N. Anchorage; St. II, XII.

DISTRIBUTION.—Australia, Oceania, Malaya, Indian Ocean, Mediterranean.

All these specimens agree with Harmer's description of young colonies of this species, but as there are no ovicells the identification is uncertain.

Tubulipora pulcherrima (Kirkpatrick).

Idmonea pulcherrima, Kirkpatrick, 1890*b*, p. 22, pl. iv, figs. 6–6*b*.
Tubulipora pulcherrima, Harmer, 1915, p. 129, pl. ix, figs. 1–5 (synonymy).
? *Diaperoecia radicata*, Canu and Bassler, 1929, p. 538, pl. lxxxii, figs. 1–5.

Occurrence.—N.E. Low Is.; W. Low Is., 6 fath.; St. II.

Distribution.—New South Wales, Loyalty Is., China Sea., Malaya, Manaar, E. Africa.

The specimen from N.E. Low Is. is small, but shows ovicells, cross-connections and a rooting-column. The ooeciostomes are broken, but the complete agreement in other characters leaves no doubt of the identity of the specimen with *T. pulcherrima*. The material from other stations is fragmentary, but there is no reason to suppose that it does not belong to the same species.

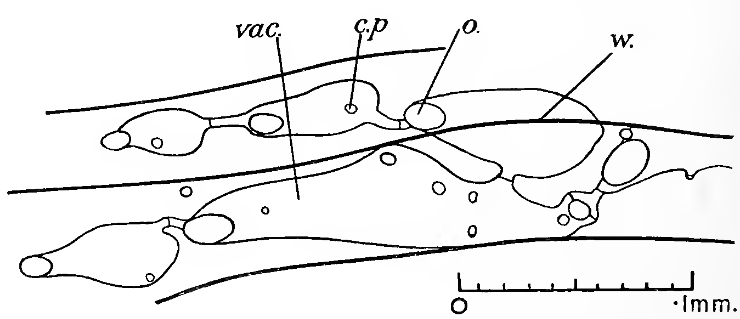
Mesonea radians (Lamarck). (Text-fig. 3.)

Retepora radians, Lamarck, 1816, p. 183.
Crisina radians, Harmer, 1915, p. 139, pl. x, figs. 6–8 (synonymy); Livingstone, 1927, p. 68.
Mesonea radians, Canu and Bassler, 1920, p. 762, text-fig. 250.

Occurrence.—N.E. Low Is.; off N. Anchorage; St. XI.

Distribution.—Australia, Oceania, Malaya, Indian Ocean.

The zoarium has a frontal layer of long tubular zooecia and a basal layer of kenozooecia. The cavities of the kenozooecia are much smaller than those of the autozooecia



Text-fig. 3.—*Mesonea radians* (Lmk.). Part of the basal layer seen by transmitted light after destruction of the autozooecia. *c.p.*, Communication pore. *o.*, Orifice of vacuole. *vac.*, Vacuole. *w.*, Lateral wall of autozooecium.

and, owing to the very thick walls, have the appearance of chambers imbedded in a solid calcareous mass. They are arranged in longitudinal series, and each opens to the exterior by an oval orifice. These are the pores in the dorsal sulci frequently described and figured in *C. radians* (*e. g.* Canu and Bassler, 1920, text-fig. 250, e). Each kenozooecium has a tubular peristome leading inwards from the orifice, at right angles to the dorsal surface of the branch. This opens into a more or less oval chamber placed longitudinally. Each kenozooecium is thus bent at a right angle. The chamber is connected by tubes with its proximal and distal neighbours in the longitudinal series of kenozooecia, and by one or more pores with the adjacent autozooecium (Text-fig. 3). Occasionally the series branch, two kenozooecia springing from the distal end of one.

Canu and Bassler (1920, p. 762) described tergopores in *Mesonea*, but later (1929, p. 549) stated that this was an error. Prof. Canu tells me (in a letter) that the word "vacuoles" should be substituted for "tergopores" in the definition of *Mesonea*. In their definitions of the different types of accessory tube, Canu and Bassler (1920, p. 645) state that adventitious tubes (*i. e.* mesopores, and vacuoles) only arise on the frontal surface, but they have subsequently written of dorsal or posterior vacuoles (*e. g.* *Reteporidea*, 1922, p. 129; *Mesonea simplex*, 1929, p. 549), so it may be assumed that they do not now regard the frontal or dorsal position as important.

Amathia convoluta, Lamouroux.

Amathia convoluta, Lamouroux, 1816, p. 160; Harmer, 1915, p. 64, pl. v, figs. 1–5.

Occurrence.—N.E. Low Is.; St. II.

Distribution.—E. Australia, Malaya.

This specimen has divided spirals of the *semispiralis* type.

Nolella alta (Kirkpatrick).

Cylindroecium altum, Kirkpatrick, 1888*b*, p. 19, pl. ii, figs. 7, 7*a*; Whitelegge, 1889, p. 293; Harmer, 1915, p. 57 (footnote).

Occurrence.—St. XII.

Distribution.—Port Phillip, Amoy (B.M. 27.8.11.18).

This fragment of a branching *Nolella* consists of three zooecia, and corresponds to Kirkpatrick's description of *Cylindroecium altum*. The larger, more profusely branched specimen from Amoy appears to belong to the same species. The smaller number of tentacles (about 10) together with the branched zooecia distinguishes *N. alta* from *N. papuensis*, in which the zooecia are unbranched and there are about 18 tentacles. The European *Anguinella palmata*, Van Beneden (see Hincks, 1880, p. 539), has 10 tentacles, and appears to be very closely allied to the present species. In specimens in the British Museum the zooecia are thicker and the branching is more profuse.

Valkeria atlantica (Busk).

Farrella atlantica, Busk, 1886, p. 37, pl. vii, figs. 3–3*g*.
Valkeria atlantica, Harmer, 1915, p. 73, pl. vi, figs. 5–12 (references); Marcus, 1921*b*, p. 20.

Occurrence.—St. II, XII, XXII.

Distribution.—Malaya, Indian Ocean, Brazil.

Buskia setigera, Hincks.

Buskia setigera, Hincks, 1887, p. 127, pl. xii, figs. 9–13; Harmer, 1915, p. 87, pl. v, figs. 8–10 (references); Hastings, 1927, p. 351; Livingstone, 1927, p. 67.

Occurrence.—N.E. Low Is.; St. XII.

Distribution.—Queensland, Malaya, China Sea, Indian Ocean.

Aetea anguina (Linnaeus).

Sertularia anguina, Linnaeus, 1758, p. 816.
Aetea anguina, Harmer, 1926, p. 194, pl. xiii, figs. 3, 4 (synonymy) ; Hastings, 1930*a*, p. 702.

Occurrence.—N.E. Low Is. ; St. XII.
Distribution.—Cosmopolitan.

Aetea truncata (Landsborough).

Anguinaris truncata, Landsborough, 1852, p. 288, pl. xvi, figs. 57, 57*.
Aetea truncata, Harmer, 1926, p. 196, pl. xiii, figs. 5–7 (synonymy) ; Hastings, 1930*a*, p. 702.

Occurrence.—N.E. Low Is. ; St. VIII.
Distribution.—Cosmopolitan.

Synnotum aegyptiacum (Audouin).

Loricaria aegyptiaca, Audouin, 1826, p. 243 ; Savigny, pl. xiii, figs. 4^1–4^5.
Synnotum aegyptiacum, Harmer, 1926, p. 398, pl. xxvii, figs. 3, 4 (synonymy) ; Osburn, 1927, p. 126 ; Hastings, 1930*a*, p. 702.

Occurrence.—St. XII, XXII.
Distribution.—W. Atlantic, Mediterranean, Indian Ocean, Malaya, Japan, Victoria, E. Pacific.

Caulibugula dendrograpta (Waters). (Text-fig. 4, a.)

Stirparia dendrograpta, Waters, 1913, p. 470, pl. lxvi, figs. 4–9.
Caulibugula dendrograpta, Harmer, 1926, p. 459, pl. xxxiii, figs. 1–4.

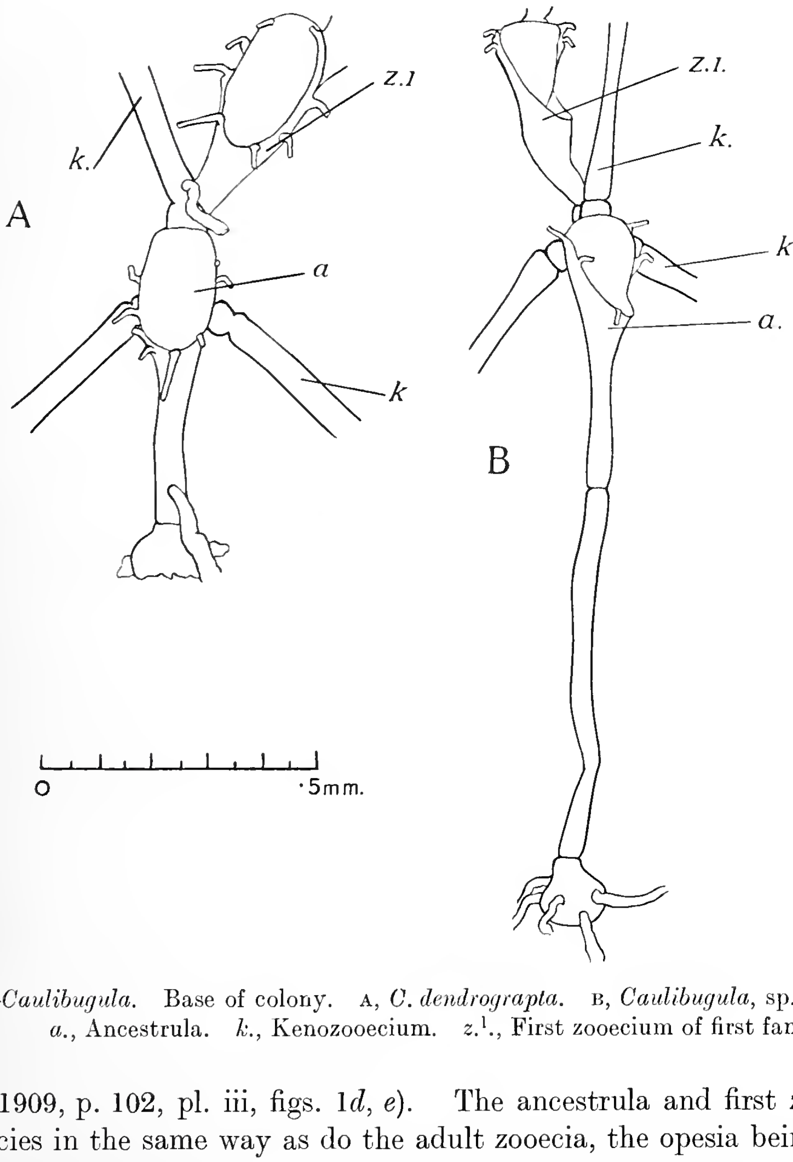
Occurrence.—St. XXI.
Distribution.—Malaya, Zanzibar, Port Phillip.*

This small specimen is part of a young colony. The turbinate ancestrula (Text-fig. 4, a) is attached to the substratum by a slightly spreading base, and by a rootlet springing from the frontal surface near the base. The opesia is oval, and has eight spines on its lateral and proximal borders, but none distally. The ancestrula gives rise to three keno-zooecia of typical form, one distal and two lateral, and to the first fan. The primary zooecium of the fan has spines all round the opesia, and arises on the basal surface of the end of the ancestrula, just proximally to the median kenozooecium. This kenozooecium gives rise distally to a series of kenozooecia which may be regarded as the main stalk of the colony, from which fans and kenozooecia are budded laterally. The specimen agrees closely with Harmer's description of *C. dendrograpta*, but there is an avicularium on nearly every zooecium, except the first of a fan and the axillary zooecium at a bifurcation.

From St. XII there is the base of a young colony of another species of *Caulibugula* (Text-fig. 4, b). It resembles *C. zanzibarensis*, Waters (1913, p. 469), in many ways, but, owing to the small size of the specimen and the absence of ovicells and stem-vesicles, the

* Waters (1913, p. 471) states that there is a specimen of this species from Port Phillip in the British Museum. One unnamed *Stirparia* (B.M. 15.10.20.5), from an unknown locality, which was sent by Mr. Waters with some Polyzoa from Zanzibar, proves to be *S. dendrograpta*. Unless this is the specimen from Port Phillip, no specimen from that locality is now in the collection.

species cannot be determined with certainty. The zooecia resemble those of *C. zanzibarensis* in shape and have a proximal avicularium of the kind found in that species, but no spine on the inner distal angle of the opesia. There may be two on the outer angle or none. The ancestrula and the zooecium and kenozooecia budded from it are arranged in the same way as those of *C. dendrograpta*. A kenozooecium appears to have been formed by constriction from the proximal part of the ancestrula, as described in *C. caliculata*



TEXT-FIG. 4.—*Caulibugula.* Base of colony. A, *C. dendrograpta.* B, *Caulibugula*, sp., from St. XII. *a.*, Ancestrula. *k.*, Kenozooecium. *z.*[1]., First zooecium of first fan.

by Levinsen (1909, p. 102, pl. iii, figs. 1*d*, *e*). The ancestrula and first zooecium differ in the two species in the same way as do the adult zooecia, the opesia being more or less oval in *C. dendrograpta* and almost triangular in the unnamed species.

Beania regularis, Thornely.

Beania regularis, Thornely, 1916, p. 161, text-fig. 6 ; Harmer, 1926, p. 418, pl. xxviii, figs. 11, 12 (synonymy).

OCCURRENCE.—N.E. Low Is. ; St. IX, XII.

DISTRIBUTION.—Holothuria Bank, N.W. Australia (B.M. 92.1.28.35) ; Malaya ; Indian Ocean.

Nellia oculata, Busk.

Nellia oculata, Busk, 1852*b*, p. 18; Harmer, 1926, p. 240, pl. xiv, fig. 18, text-figs. 3B, D, 4A, B (synonymy); Livingstone, 1927, p. 52; Osburn, 1927, p. 125; Canu and Bassler, 1928*b*, p. 26.

Occurrence.—W. Low Is., 6 fath.; St. IX, XII, XXI, XXII.

Distribution.—Australia, Malaya, Amoy (B.M. 27.8.11.15), Indian Ocean, E. Atlantic.

A specimen of the typical form is in a collection sent to the British Museum from Amoy in 1926 by Dr. C. Ping, and this collection also includes var. *quadrilatera*. The Barrier Reef collection only contains the typical form.

From St. XXI there are several small complete colonies attached to discoidal Foraminifera from the surface of a sponge. The Polyzoa are slung by a number of rootlets, the proximal zooecium not being in contact with the substratum.

Didymozoum triseriale (Philipps).

Didymia triserialis, Philipps, 1899, p. 442, pl. xlii, figs. 2, 2*a*.
Didymozoum triseriale, Harmer, 1926, p. 407, pl. xix, fig. 1.

Occurrence.—St. XXII.

Distribution.—Malaya, Oceania.

Retiflustra cornea (Busk).

Retepora cornea, Busk, 1852*a*, p. 380.
Retiflustra cornea, Harmer, 1926, p. 250, pl. xv, fig. 3, text-fig. 8 (synonymy).

Occurrence.—St. VIII.

Distribution.—N. Australia, Malaya (Aru Is., New Guinea).

Scrupocellaria maderensis, Busk.

Scrupocellaria maderensis, Busk, 1860, p. 280; Harmer, 1926, p. 372, pl. xxv, figs. 16–19 (synonymy).

Occurrence.—N.E. Low Is.

Distribution.—Malaya, Japan, Indian Ocean, E. Atlantic, W. Atlantic (B.M. 31.12.19.5, Tortugas).

Scrupocellaria diadema, Busk.

Scrupocellaria diadema, Busk, 1852*a*, p. 370; Harmer, 1926, p. 375, pl. xxv, figs. 20–25 (synonymy); Livingstone, 1927, p. 52; Canu and Bassler, 1929, p. 211, pl. ix, figs. 4, 5.

Occurrence.—N.E. Low Is.; St. II, VIII, XII.

Distribution.—Australia, Malaya, Japan, Indian Ocean.

Scrupocellaria delilii (Audouin).

Crisia delilii, Audouin, 1826, p. 242; Savigny, pl. xii, figs. 3^1–3^5.
Scrupocellaria delilii, Harmer, 1926, p. 370, pl. xxv, figs. 12–15 (synonymy).
Scrupocellaria macandrei, Livingstone, 1927, p. 53.

Occurrence.—W. Low Is., 6 fath.; St. IX, XII.

Distribution.—Australia, Malaya, Japan, Red Sea, Mediterranean, Madeira.

Scrupocellaria spatulata (d'Orbigny).

Cellularia spatulata, d'Orbigny, 1851, p. 50.
Scrupocellaria spatulata, Harmer, 1926, p. 382, pl. xxvi, figs. 1–10 (synonymy).
Scrupocellaria cervicornis (pars), Livingstone, 1927, p. 53.

Occurrence.—St. XII.

Distribution.—E. Australia, Malaya, Indian Ocean, Florida.

Two small pieces agree with Harmer's description of *S. spatulata* in the form of the zooecia, the number and position of spines, the form and position of vibracula and scuta and in the barbed rootlets. Ovicells, frontal avicularia and enlarged marginal avicularia are absent, but the agreement in the other characters is so close that the identification is made with fair confidence. One piece includes the ancestrula, which has the form frequently found in cellularine Polyzoa (*e. g.* Busk, 1852*b*, pl. xxiii, fig. 1 ; Hastings, 1930*a*, pl. i, figs. 1 and 4) and has eleven spines evenly distributed round the opesia.

Caberea lata, Busk.

Caberea lata, Busk, 1852*a*, p. 378 ; Harmer, 1926, p. 360, pl. xxiv, figs. 7–9 (synonymy) ; Livingstone, 1927, p. 53.

Occurrence.—St. XII.

Distribution.—Queensland, Malaya, Japan, Indian Ocean.

Caberea boryi (Audouin).

Crisia boryi, Audouin, 1826, p. 242 ; Savigny, pl. xii, figs. 4^1–4^6.
Caberea boryi, Harmer, 1926, p. 362, pl. xxiv, figs. 13–15.

Occurrence.—St. IX, XII.

Distribution.—Malaya, Japan, Indian Ocean, Mediterranean.

Caberea transversa, Harmer.

Caberea transversa, Harmer, 1926, p. 363, pl. xxiv, figs. 5, 10 ; Canu and Bassler, 1929, p. 214, pl. xxxviii, figs. 9, 10.

Occurrence.—St. XII.

Distribution.—Malaya.

Harmer mentions the relationship of his species to the Australian *C. glabra*, Macgillivray (1886, p. 129), which differs in its large spines and frontal avicularia. In specimens of *C. glabra* in the British Museum the large spines are not present on all parts of the colony. It would not be easy to distinguish such spineless parts from *C. transversa*, and the occurrence of both species on the Australian coast suggests that they may be synonymous.

Acanthodesia savartii (Audouin).

Flustra savartii, Audouin, 1826, p. 240 ; Savigny, pl. x, figs. 10^1, 10^2.
Acanthodesia savartii, Harmer, 1926, p. 213, pl. xiii, figs. 8, 13, 14, 16 (synonymy) ; Livingstone, 1927, p. 54 ; Canu and Bassler, 1929, p. 66, pl. i, figs. 1–5.

Occurrence.—Low Is., 12 fath. ; St. XIII.

Distribution.—Australia, Malaya, Japan, Indian Ocean, Morocco, Florida.

Chaperia acanthina (Lamouroux).

Flustra acanthina, Lamouroux, 1825, p. 605, pl. lxxxix, figs. 1, 2.
Chaperia acanthina, Harmer, 1926, p. 229, pl. xiv, figs. 9, 10 (synonymy); Livingstone, 1927, p. 54; 1929, p. 100; Canu and Bassler, 1929, p. 472, text-figs. 201D–G, 202.

OCCURRENCE.—St. II.

DISTRIBUTION.—Australia, New Zealand, Malaya, Indian Ocean, Falkland Islands.

This young colony consists of the ancestrula and first three zoecia, but they show the characters of the species and can be identified with fair confidence.

Setosellina coronata (Hincks).

Membranipora coronata, Hincks, 1881*b*, p. 147, pl. x, fig. 1.
Setosellina coronata, Harmer, 1926, p. 265, pl. xvi, figs. 2–4 (synonymy).
Ellisina coronata, Livingstone, 1927, p. 54.

OCCURRENCE.—St. XXII.

DISTRIBUTION.—Australia, Malaya, Indian Ocean.

The specimen was dead when collected and only the calcareous parts remain. These are, however, sufficiently characteristic for determination.

Cupuladria guineensis (Busk).

Cupularia guineensis, Busk, 1854, p. 98, pl. cxiv.
Cupuladria guineensis, Harmer, 1926, p. 266, pl. xvi, figs. 5–7, text-fig. 9 (synonymy).
Cupuladria guineensis, *intermedia* and *brevipora*, Canu and Bassler, 1929, p. 74.

OCCURRENCE.—Low Is., 12 fath.

DISTRIBUTION.—Australia, Malaya.

Canu and Bassler (1929, p. 74) introduce new names for species identified as *Cupuladria guineensis*, Busk, as follows:

C. guineensis, Busk, 1854, type of the species.
,, ,, 1884 = *C. intermedia*, Canu and Bassler, 1929.
,, Harmer, 1926 = *C. brevipora*, ,, ,,

Their conclusions are based on the published figures and descriptions, some of which are misleading, as examination of the original specimens in the British Museum shows. Busk's figure of the holotype (1854, pl. cxiv, fig. 3) gives an impression of a tuberose basal surface, and for this reason Canu and Bassler regard the later specimens, which have a pitted basal surface, as distinct. The specimen figured by Busk has, however, a pitted basal surface. Some of the pits have slightly raised borders, but the majority form no projection at all. All three specimens thus agree in having a pitted basal surface. Canu and Bassler would further distinguish *C. guineensis*, Harmer, 1926, from the others on the shape of the opesia. The fact is, however, that Harmer gave the first adequate account of the variation in the form of the opesia, and that the various shapes mentioned by him are found in all the specimens.

Canu and Bassler maintain the separation of *C. stellata* (Busk, 1854). Busk distinguished the species by the serrate edge of the colony and the narrow smooth cryptocyst. Each serration consists of the distal part of one zooecium with its distal

vibraculum. These do not project any more than in other species of *Cupuladria*, but owing to the small size of the colonies they are more conspicuous. The stellate appearance of the colony can thus be regarded as characteristic of young colonies. The cryptocyst is rather narrow in the type-specimen and descends steeply. It is tuberculate, as in *C. guineensis*. The basal surface of the figured type-specimen is not smooth, as in Busk's figure, but roughened and pitted. It has not, however, the conspicuously tuberose surface of *C. dentifera*, Canu and Bassler (1929, p. 75). The differences between *C. guineensis* and *C. stellata* are thus slight, and I agree with Marcus (1921*b*, p. 8) and Harmer (1926, p. 266) that *C. stellata* is a young colony of *C. guineensis*.

Steganoporella buskii, Harmer.

Steganoporella buskii, Harmer, 1900, p. 272, pl. xii, fig. 13; pl. xiii, figs. 33–35; 1926, p. 279 (references); Livingstone, 1927, p. 56.

Occurrence.—Low Isles (shore).

Distribution.—Australia, Malaya, Indian Ocean.

These specimens are encrusting. There is slight variation in the sclerites of the B-opercula, their parallel portions sometimes being shorter than in that figured by Harmer, but the majority are typical. Similar slight variability is found in most of the specimens in the British Museum identified with this species by Harmer.

Thalamoporella rozieri (Audouin).

Flustra ? rozieri, Audouin, 1826, p. 239; Savigny, pl. viii, figs. 9[1], 9[2].
Thalamoporella rozieri, Harmer, 1926, p. 292, pl. xix, figs. 3–13 (synonymy); Livingstone, 1927, p. 56.

Occurrence.—Batt Reef.

Distribution.—Australia, Malaya, Indian Ocean, Cape Verde Is., S.W. England.

Cellaria punctata (Busk).

Salicornaria punctata, Busk, 1852*a*, p. 366.
Cellaria punctata, Harmer, 1926, p. 337, pl. xxi, figs. 14–16, text-fig. 13*a* (synonymy).
Cellaria gracilis, Livingstone, 1927, p. 57.

Occurrence.—St. II.

Distribution.—E. and N.E. Australia, Malaya, Indian Ocean.

Hippopodina feegeensis (Busk).

Lepralia feegeensis, Busk, 1884, p. 144, pl. xxii, fig. 9; Livingstone, 1926*a*, p. 94.
Lepralia feegensis, Waters, 1913, p. 514, pl. lxx, figs. 21, 22 (references).
Cosciniopsis fallax, Canu and Bassler, 1929, p. 276, pl. xxviii, fig. 7, text-fig. 113A–D.
? not *Hippopodina feegeensis*, Levinsen, 1909, pl. xxiv, fig. 3*a*, *b*.
? not *Hippopodina feegensis*, Hastings, 1930*a*, p. 729.

Occurrence.—St. XIII.

Distribution.—Australia, Malaya, Indian Ocean.

Busk described the ovicells of this species as inapparent, and this has led some authors to the belief that the true *H. feegeensis* has endozooecial ovicells. Canu and Bassler introduced the name *Cosciniopsis fallax* for the supposedly distinct form with large ovicells. Busk's type-specimen has, however, large ovicells exactly like those figured in *C. fallax* and there can be no doubt that *C. fallax* is a synonym of *H. feegeensis*.

Since *L. feegeensis*, Busk, is the genotype of *Hippopodina*, Levinsen (1909, p. 353), the presence of large, hyperstomial ovicells invalidates the expanded definition of the genus given by Canu and Bassler (1920, p. 532).

The specimens from Gorgona (Hastings, 1930*a*) resemble those figured by Levinsen (1909, pl. xxiv, fig. 3*a*, *b*) in the shorter avicularia and smaller, more immersed ovicells; the ovicells being ·4 to ·45 mm. wide and those of the type ·76 mm. Levinsen's specimens came from St. Thomas, W. Indies, and it seems possible that the American form is distinct from the Indo-Pacific one, though Osburn (1927) had specimens with long and short avicularia from Curaçao. The Pliocene specimens from Bocas Island, Panama (Canu and Bassler, 1928*b*, p. 133) appear, however, to be of the typical form.

Lepralia montferrandii (Audouin).

Flustra montferrandii, Audouin, 1826, p. 240; Savigny, pl. ix, figs. 14^1, 14^2.
Lepralia montferrandii, Waters, 1909, p. 171, pl. xvii, figs. 15–18 (synonymy).

OCCURRENCE.—St. XIII.

DISTRIBUTION.—Queensland, Port Phillip Heads (B.M. 88.11.14.317), Tizard Bank (B.M. 89.8.21.103, 104), Ceylon, Red Sea.

I have examined the specimen from the Red Sea identified with Audouin's species by Waters. It much resembles the Barrier Reef specimen. The orifice of the former is on the average broader in its proximal part, with a straighter lower lip, but there is variation in both specimens. The spatulate avicularium of that from the Red Sea is smaller and more oblique, and the thickened border of the operculum is conspicuous owing to its brown colour. Waters regarded the Queensland species, which is very probably *L. mortoni*, Haswell (1881, p. 40), as identical with that from the Red Sea, and in spite of their slight differences I am inclined to agree with him. Livingstone (1927, p. 63) recorded both species from Queensland.

Thornely (1905, p. 119) recorded *L. mortoni* from Ceylon. Part of her specimen is in the Cambridge Museum and is referable to *L. montferrandii*. The specimen from the same locality identified by Waters (1909, p. 171) with *L. montferrandii* has been lent to me and is a distinct species. As mentioned by Waters, the frontal wall has marginal areolae and a central imperforate area, and the peristome is somewhat raised.

A number of species resembling *L. montferrandii* have been named, and it is uncertain how many of them are really distinct. A specimen from Japan in the Cambridge Museum identified, probably correctly, with *L. acuta*, Ortmann (1889, p. 41), is very similar, but has the proximal end of the oblique spatulate avicularium in the middle of the zooecium, that of *L. montferrandii* being more lateral—a very slight distinction. A specimen of *L. obtusata*, Ortmann (1889, p. 41), from Japan in the Cambridge Museum has all the avicularia obtuse and median. The large, spatulate ones may be longitudinal or very slightly oblique. Other species of this group are *L. anatina* (Canu and Bassler, 1927*b*, p. 26) from Hawaii and *L. granulata* (Canu and Bassler, 1930, p. 29; Hastings, 1930*a*, p. 725) from the Galapagos Islands.

These forms agree in having a uniformly punctured frontal wall, an ovicell uniformly, but rather less closely punctured, a median, backwardly-directed avicularium on most of the zooecia, a more or less round orifice, and (where it has been examined) an operculum with a pair of articular projections (Waters, 1909, pl. xvii, fig. 16; Hastings, 1930*a*,

pl. xiii, fig. 83). In these characteristics they agree with *Lepralia galeata*, Busk (1854,* p. 66), the genotype of *Codonella*, a genus introduced by Canu and Bassler (1927*b*, p. 26) for this group of species. The name *Codonella* cannot stand, however, having been used by Haeckel (1873, p. 564) for a genus of Infusoria. Pending the introduction of another name it has seemed convenient to put them into *Lepralia*, used, as proposed by Canu and Bassler (1927, p. 32), as a temporary name for unplaced species.

Comparison of the type-specimen of *L. galeata* with Calvet's description of *L. gemelliporoides* (1904, p. 23) shows that they are synonymous, as maintained by Waters (Calvet, 1904, p. 24). *L. galeata*, Busk (1879, p. 195), from Kerguelen, appears to be distinct, having the central part of the frontal wall imperforate and having marginal areolae, an operculum of a different shape, and a considerably raised avicularium with a larger, more spatulate mandible.

Schizomavella.

Two species in the collection, *S. lata* and *S. australis*, with *S. triangula* (Hincks, 1881*c*, p. 12) and *S. ambita* (Waters, 1889, p. 11), must probably be separated from *Schizoporella*, Hincks (1877, p. 527), genotype *S. unicornis*, Johnston.† Waters (1904, p. 49) defined several groups of Schizoporellid species. He expressed the opinion that the group containing *S. lata*, *S. triangula* and *S. ambita* deserved generic rank, and suggested the use of *Gemellipora*, Smitt (1873, p. 35). According to Canu and Bassler (1928*b*, p. 151) he made *G. glabra* the genotype. As I understand him, his intention was not to select *G. glabra*, which he never mentions, but to point out that if " the first species mentioned by Smitt " (*i. e. G. eburnea*, which he thus clearly regards as the genotype) should be a *Pasythea*, the name *Gemellipora* would be synonymous with *Pasythea*, and not available for Smitt's other species and their congeners. *G. eburnea* is the only species included in the genus by Levinsen (1909, p. 313), and even if the virtual selections of Smitt himself (quoted by Canu and Bassler, 1928, p. 151, footnote) and of Waters are not accepted, Levinsen's selection is valid, and has priority over the selection of *G. glabra* by Canu and Bassler (1920, p. 369). As pointed out by Canu and Bassler (1928*b*, p. 151), Macgillivray (1895, p. 87) and Maplestone (1902, p. 71) both used *Gemellipora*. They did not, however, express an opinion on the genotype. *S. lata*, and its allies do not appear to have any special relationship to *G. eburnea*, and cannot be put in *Gemellipora*.

A glance at the figures of *S. auriculata* (Hassall), reproduced by Canu and Bassler (1920, p. 354, text-figs. 107 F, G), will show that there is not complete agreement as to the shape of the orifice. Examination of the British specimens in the British Museum and comparison with Johnston's figure (1847, pl. liv, fig. 8, which, according to Hassall, 1842, p. 411, was to be furnished by him) and of Hincks (1880, pl. xxix, figs. 3–5), satisfies

* The date 1852 given by Canu and Bassler is that of Vol. I of the British Museum Catalogue, but *L. galeata* is described in Vol. II.

† Waters (1904, p. 49) overlooked Hincks's selection, and assumed that *S. sanguinea* or *S. linearis* included in the genus by Hincks (1879, p. 157) would be the genotype. His *Schizoporella*, s. str., is not, therefore, the group of species to which the name really belongs. He repeats this mistake in 1913 (p. 505).

Canu and Bassler (1920, p. 335) have also overlooked Hincks's selection, but mention *S. unicornis* as the first species described. They introduce *Schizopodrella* with *S. unicornis* as genotype, and propose to use *Schizoporella*, " at least provisionally, for all the species imperfectly studied and classed." The convenience of a miscellaneous genus of this kind is obvious, but the use of a name that has been properly introduced with a well-known species as genotype, and the introduction of another genus with the same genotype cannot be accepted. *Schizoporella* and *Schizopodrella* are therefore regarded as synonymous.

me that the true *S. auriculata* has an orifice resembling that of the ordinary zooecia of *S. lata* and *S. triangula*. This shape is difficult to define briefly and accurately, but, seeing text-fig. 5 A, the description "roundly triangular," used in this paper, will be readily intelligible.

S. triangula and its allies appear to be so closely related to *S. auriculata* (see also p. 418) that, in spite of the opercular dimorphism, they should be regarded as congeneric. They agree in the more or less uniform perforation of the frontal wall and ovicell (the latter sometimes being partially covered by an imperforate crust formed by secondary calcification); in the shape of the orifice of the ordinary zooecium; in the attachments of the occlusor muscles of the operculum, which are near the margin and connected to it by a little sclerite; in the median avicularium just proximal to the orifice. The very different degree of dimorphism found in these species (*e.g.*, the slight dimorphism of *S. lata*) supports the view, already expressed by Waters (1918*b*, p. 99), that dimorphism of the opercula is not a generic character. As *S. auriculata* is the genotype of *Schizomavella*, Canu and Bassler (1917, p. 40), the most satisfactory course seems to be to put *S. triangula* and its allies in this genus. As pointed out by Livingstone (1929, p. 80), the genus *Metroperiella*, Canu and Bassler (1917, p. 40), in which *S. lata* has sometimes been placed, is now merged in *Schizomavella*.

Though all the species of *Schizomavella* here discussed have a roundly triangular orifice, no implication that species with a differently shaped orifice should be excluded is intended.

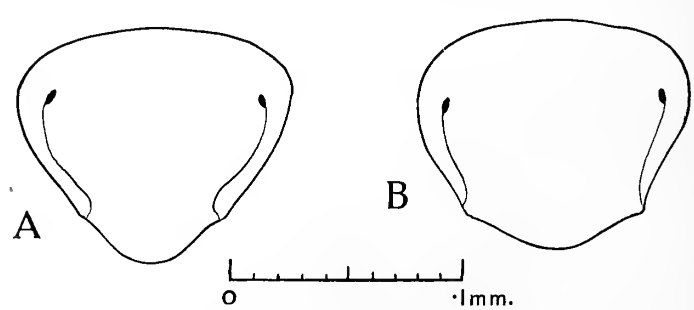
Schizomavella lata (Macgillivray). (Text-fig. 5.)

Schizoporella lata, MacGillivray, 1883, p. 132, pl. i, fig. 7; Waters, 1889, p. 10.
Schizoporella (*Metroperiella*) *lata*, Livingstone, 1929, p. 79 (references).
? *Schizoporella auriculata*, Kirkpatrick, 1890*a*, p. 617.

OCCURRENCE.—St. XIV.

DISTRIBUTION.—Australia, New Zealand.

There is one small colony which must be identified with Macgillivray's species. The colony is young, and is still very transparent and delicately calcified. There is a small



TEXT-FIG. 5.—*Schizomavella lata* (Macg.). Operculum of ordinary zooecium (A) and fertile zooecium (B).

raised, triangular avicularium on the frontal wall proximal to the orifice and directed obliquely backwards. The opercula of the ordinary zooecia are roundly triangular; those of the fertile zooecia are more quadrangular (Text-fig. 5, A, B). The ovicell is uniformly punctured. The condyles are denticulate.

The avicularia of the Tertiary form figured by Macgillivray (1895, pl. xi, fig. 5)

resemble those of *S. triangula*, described below (pp. 417–418), rather than those of *S. lata*. It is impossible without examining the specimens to tell whether *S. lata*, Thornely (1912 p. 148), is Macgillivray's species or not.

The specimen from Torres Straits, identified by Kirkpatrick (1890*a*, p. 617) with *S. auriculata*, is only represented in the British Museum by a preparation of the chitinous parts (B.M. 32.2.2.2), but the possession of two types of opercula, identical in form with the corresponding opercula of *S. lata*, proves it to have been, as was surmised by Kirkpatrick, a specimen of that species rather than *S. auriculata*. The majority of the mandibles are pointed, but a few are semicircular.

S. lata is closely allied to *S. ambita*, Waters (1889, p. 11). The ovicell of *S. ambita* is larger and flatter and an imperforate crust grows up round it. The orifice of the fertile zooecium is larger, corresponding to the large ovicell. The avicularium is very small in both.

Schizomavella australis (Haswell). (Pl. I, fig. c.)

Hemeschara australis, Haswell, 1881, p. 41, pl. ii, figs. 7, 8.
Schizoporella australis, Harmer, 1902, p. 303, pl. xvii, fig. 47 ; Livingstone, 1927, p. 61.

Occurrence.—N.E. Low Is. ; Low Is., 12 fath.

Distribution.—Queensland, Port Darwin, 8–12 fath. (B.M. 82 . 2 . 23 . 511) ; Holothuria Bank, N.E. Australia, 9–36 fath. (B.M. 92.1.28.75) ; Saghalien, Japan (B.M. 62.7.16.3) ; Singapore (B.M. 86.10.19.1–3).

There can be no doubt of the identity of these specimens with *S. australis*. I have compared them with part of Haswell's material and with Harmer's specimen from Torres Straits, both belonging to the Cambridge Museum.

The colonies (Pl. I, fig. c) have the branched and anastomosing tubular structure figured by Haswell. There is, however, some variation, for the two pieces from the Holothuria Bank are more slender, more irregularly and profusely branched, and show a greater tendency to the formation of irregular superficial layers. In zooecial characters they are indistinguishable from the other specimens. The colony from Port Darwin is complete basally and is attached to a stone by an extensive encrustation, consisting of autozooecia like those forming the erect parts.

There is a good deal of variation in the development of the narrow raised lines outlining the zooecia. In extreme cases they may be conspicuous all round the zooecia or entirely absent. The orifices of the non-fertile zooecia vary very slightly in the depth of the sinus, the opercula varying correspondingly. The orifices of the fertile zooecia are distinctly broader, though the difference is not so pronounced as in some allied species (*e. g. S. ambita* and *S. triangula*). The ovicell is hyperstomial and closed by the operculum. It is flat frontally and sunk in the distal zooecium, and is therefore not very prominent, though, being as wide as the zooecium, it is large. Its sculpture is like that of the frontal wall.

The mandible of the large, proximally directed, frontal avicularia lies, when open, right back against the frontal wall and fits into a groove, which has a rounded end and is fairly uniform in width. These avicularia are only found on some zooecia. Some have no avicularia, and others have a small median one on the proximal side of the orifice directed obliquely towards the distal end of the zooecium. These small avicularia resemble the large ones in having a mandible which lies in a groove when open. *S. triangula* also

has a depressed area of the frontal wall proximal to the avicularium, and corresponding in shape to the mandible, which rests in it when open.

In a decalcified and stained preparation the oral glands are rather conspicuous. The polypides are only remarkable for the cæcum, which is sharply defined and very little longer than broad.

S. machaira, Marcus (1922, p. 436), appears to be allied to this species. It differs chiefly in the small number of large irregular pores in the ovicell. The two teeth on the mandible were not seen in *S. australis*. The absence of oral glands in *S. machaira* may only be a seasonal difference.

It seems possible that *S. australis* may, like *S. lata*, and perhaps *S. triangula*, sometimes have been confused with *S. auriculata*. A specimen sent by the Australian Museum as *S. auriculata* proves to be *S. australis*. I have seen no undoubted specimen of *S. auriculata* from Australia. That of Hincks (1880, p. 263) from Glenelg (B.M. 99.5.1.988) is very small and without ovicells, and might equally well be another species of this group.

Emballotheca, sp. (Text-figs. 6, A, 7.)

Occurrence.—St. XII, XXII. Prince of Wales Channel, Torres Straits, 4 fath. (B.M. 82.2.23.82, 525); Murray Island, Torres Straits (B.M. 90.7.23.53); Torres Straits, 10 fath. (B.M. 82.2.23.411); Torres Straits (Cambridge Museum, Coll. Haddon); Port Molle, Queensland (B.M. 81.10.21.5).

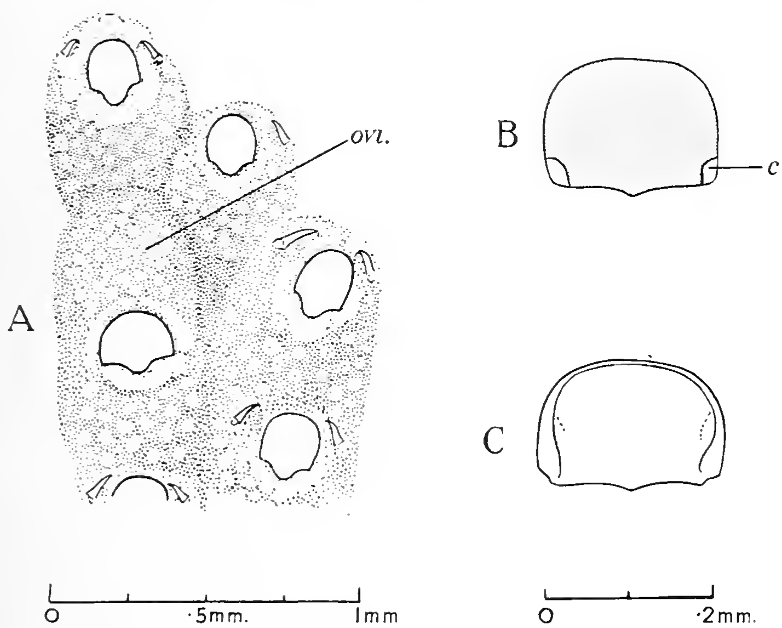
Description.—The zoarium is encrusting or erect and unilaminar or tubular. The zooecia are usually more or less rectangular and arranged regularly, but a superficial layer of irregular zooecia may be formed. The frontal wall and ovicell are uniformly punctured with rather large pores, and there may be some nodular thickening round the orifice (Text-fig. 6, A). The ovicell is large and deeply immersed. The orifice of the non-fertile zooecium is longer than broad; that of the fertile zooecium is broader than long. On many zooecia there is a small avicularium in each distal corner. This avicularium is directed towards the median line on the distal side of the orifice. The beak is somewhat raised and the mandible is narrow and acute. The operculum of the non-fertile zooecium has a thickened border forming a flange on each side to which the occlusor muscles are attached, and sockets at the proximal corners for articulation to the condyles (Text-fig. 7, A). The operculum of the fertile zooecium (Text-fig. 7, B) has a strong sclerite, which is marginal proximally, but round the curved border is a little distant from the edge. Irregularly lobed processes, which appear to be chitinous, project from the distal part of the sclerite.

Remarks.—I have been unable to recognize this species with certainty in any description, but there are several more or less resembling it, so I hesitate to name it as new.

From its occurrence on the Queensland coast and in Torres Straits its presence in Haswell's collection is probable, and there are two species briefly described and not figured by Haswell (1881, p. 39) which somewhat resemble it, namely, *Lepralia*, sp., and *L. assimilis*. The former seems nearer to it, but both are described with a narrow sinus.

Schizoporella subsinuata, Marcus (1921*b*, p. 16), is similar. The distal avicularia are mentioned by Marcus, though not present on the figured zooecia. The ovicells in Marcus's fig. 8*a* are more prominent, and in fig. 8*c* their pores are shown as still clearly visible after decalcification, and the opercula differ slightly in shape. There can be no doubt that

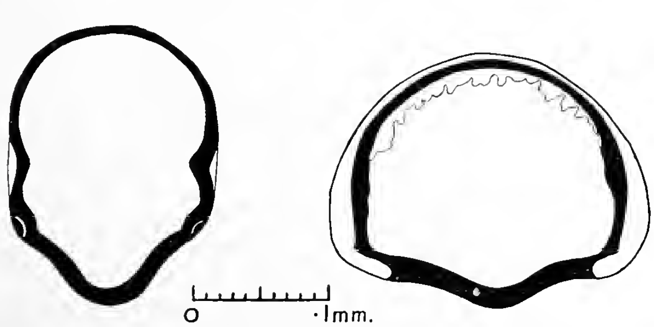
Marcus had not got *S. subsinuata*, Hincks (1884*b*, p. 280). Hincks figured a specimen with a wide, roughly rectangular orifice with a notch in the proximal border, and his figure is accurate, for some specimens, such as those from Port Phillip (B.M. 88.11.14.414; 97.5.1.767. 827), agree with it exactly. Others have the proximal border, in at least



TEXT-FIG. 6.—A, *Emballotheca*, sp. Dry specimen with ectocyst intact. B and C, *Schizoporella subsinuata*, Hcks., from Port Phillip. B, Orifice. C, Operculum. *c.*, Condyle. *ovi.*, Ovicell.

some zooecia, straight or slightly curved, but not notched. All agree in the general shape of the orifice and of the thick condyles in the proximal corners (Text-fig. 6, B). The operculum (Text-fig. 6, C) is very different from that of Marcus's species.

Other species more or less resembling the Barrier Reef species are described by Canu and Bassler (1929, pp. 297–302) under *Emballotheca*. Of these, *E. capitifera* is probably



TEXT-FIG. 7.—*Emballotheca*, sp. Operculum of ordinary zooecium (A) and fertile zooecium (B).

the nearest, but it differs in the shape of the operculum and in the presence of vicarious and absence of adventitious avicularia.

The attribution of the present species to *Emballotheca*, Levinsen (1909, p. 333), is in accordance with Levinsen's conception of the genus, both *E. furcata* (see footnote, p. 422) and *E. subimmersa* appearing to be allied species. It is, however, unlikely that any of

these three species should be regarded as congeneric with *E. quadrata*, the genotype (Canu and Bassler, 1920, p. 366), which differs in the large curved teeth in the orifice, in the convex proximal border of the orifice and in the operculum.

Stylopoma. (Text-fig. 8.)

The genotype of *Stylopoma* is the W. Indian species figured by Levinsen (1909, pl. xviii, figs. 4 *a–c*), this being clearly the species intended by Canu and Bassler (1920, p. 359), for in repeating their selection (1923, p. 101) they reproduced Levinsen's figures. They showed their specimens from the Gulf of Mexico (1928*b*, p. 92, text-fig. 14 B) with a more uniformly tapering tongue to the operculum and no denticles in the aperture. In the first point at least the specimens of Smitt (1873, p. 42) agreed with Levinsen's, for the sinus was " proximally a little dilated." Specimens from the Tortugas (B.M. 31.11.19.22) and the Galapagos Islands (Hastings, 1930*a*, p. 721) agree with Levinsen's figure and description.

The characters of the genotype of *Stylopoma* are, therefore, sufficiently clearly defined, but the name *E. spongites*, Pallas (1766, p. 45), is not available for it, for Pallas almost certainly confused two species, one from the Mediterranean, to which the name should be restricted (Harmer, 1930, p. 80), and one from America, which is probably the well-known West Indian *Stylopoma.* Canu and Bassler (1923, p. 102) suggested that the name *S. informata* (Lonsdale, 1845, p. 505) could be used for the latter species, and this course has been adopted here.

An ovicellular operculum like that described below (p. 425) is present in all forms of *Stylopoma* examined by me, and may be a generic character.

A tendency to chitinization of the ectocyst round the orifice has been noticed in several of the forms examined, and, as it is almost impossible to separate the operculum completely, it is often difficult to decide which of the visible lines is its true proximal border. The outlines here given have been obtained by careful comparison of decalcified specimens stained with borax-carmine and picric acid, both mounted whole and teased apart, with undecalcified specimens cleared and mounted whole and crushed to separate the opercula. It is possible that the disc-like tip of the tongue (Text-fig. 8, G, K) may not be truly part of the operculum, but it certainly appears to be.

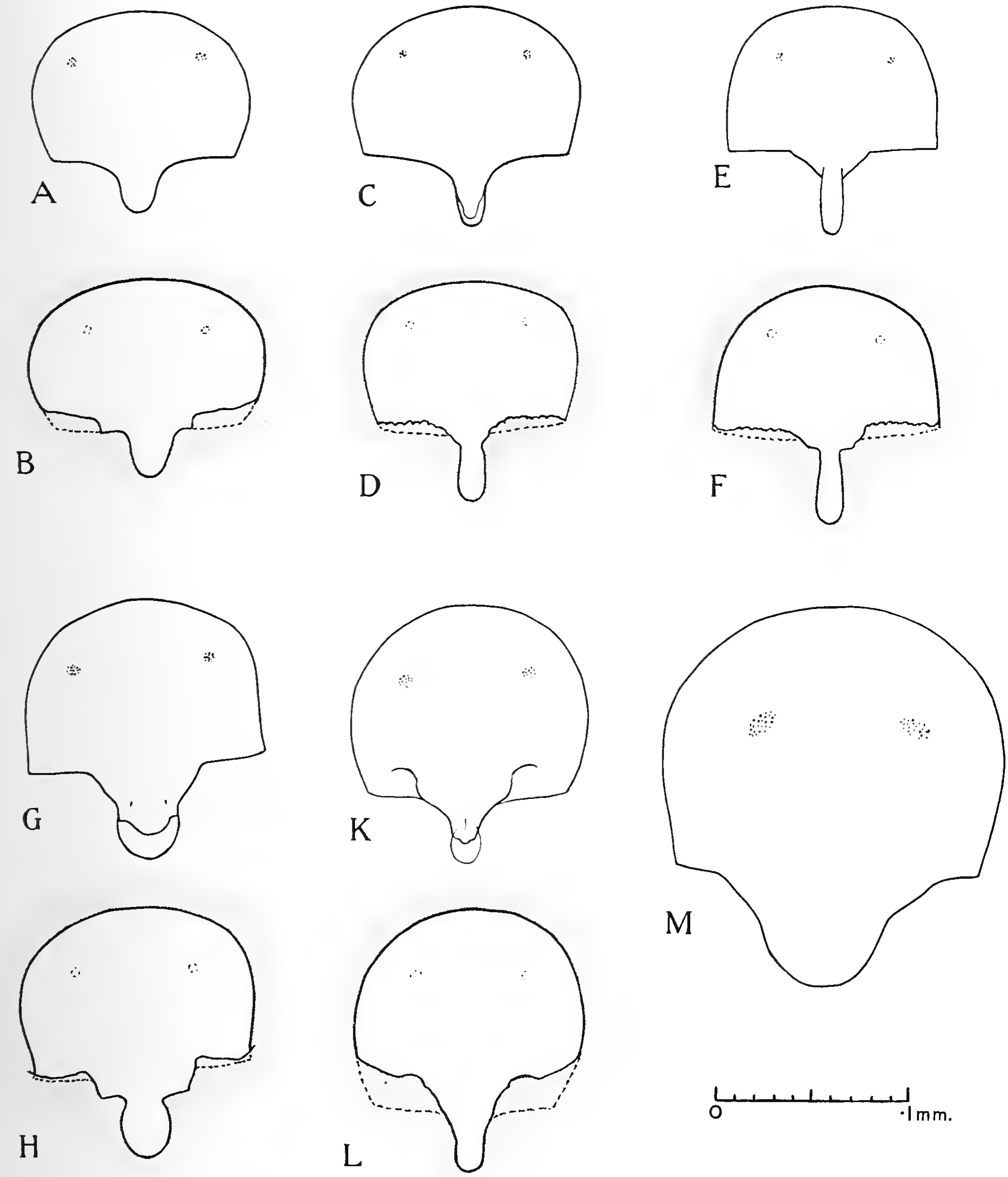
The orifice in *S. informata* (Text-fig. 8, G, H) and *S. schizostoma* (Text-fig. 8, A–F) is more or less semicircular, with a median sinus in the straight proximal margin. The straight edge on each side of the sinus bears a flat plate, which joins the lateral border of the orifice, but may not reach the corner of the sinus (Text-fig. 8, B, H). The edge of the operculum overlaps this plate, which clearly corresponds to the condyle or hinge-tooth in other forms and is here called the condyle.

Stylopoma schizostoma (MacGillivray). (Text-figs. 8, A–F, 9.)

Lepralia schizostoma, MacGillivray, 1868, p. 135.
Schizoporella schizostoma, Macgillivray, 1889, p. 28.
Stylopoma parviporosa, Canu and Bassler, 1929, p. 315, pl. xxxvi, figs. 3–6, text-fig. 131B.

OCCURRENCE.—St. XII, XIII.

DISTRIBUTION.—S. Australia; Victoria; Murray Island, Torres Straits (B.M. 31.9.11.14, 90.3.24.18); West Island, Torres Straits, 17 fath. (B.M. 82.2.23.535); Clairmont Island, N.E. Australia, 11 fath. (B.M. 82.2.23.551); Holothuria Bank, N.W.



TEXT-FIG. 8.—*Stylopoma.* Operculum alone and orifice with operculum in position of: A–F, *S. schizostoma* (Macg.); A, B, from Barrier Reef; C, D, from Fort Phillip; E, F, from Torres Straits. G. H, *S. informata* (Lonsd.), from Galapagos. K, L, *Stylopoma*, sp., from Mascarenes. M, Operculum of *S. viride* (Thorn.). Calcareous parts stippled. Portions of opercula overlying calcareous parts shown by dotted lines.

Australia, 34 fath. (B.M. 92.1.28.43); Amboyna (B.M. 84.2.22.3); New Harbour, Singapore, 7–10 fath. (Cambridge Museum, Coll. Hanitsch); Papeete, Tahiti (B.M. 29.4.25.4); Tizard Bank (B.M. 89.8.21.80); Philippines.

As represented by specimens from Port Phillip in the Bracebridge Wilson Collection (B.M. 97.5.1.763, 764), *S. schizostoma* has a rather narrow sinus and denticulate condyles (Text-fig. 8, C, D). In the specimen from West Island the sinus is longer and narrower (Text-fig. 8, E, F) and the tongue of the operculum is strongly arched, following the contour of the frontal wall, which descends rather steeply to the proximal border of the orifice. As in the Port Phillip specimen, the condyles are toothed. Their surface is ridged and the ectocyst between these ridges is chitinized, so that in preparations of decalcified zooecia the operculum appears to be fringed proximally with long thin teeth. Specimens of *S. parviporosa*, Canu and Bassler, from Romblon and Jolo, Philippines, received from the U.S. National Museum, are more or less intermediate between the two types described above. In the shape of the orifice they agree with those from Port Phillip, but the specimen from Jolo shows some arching of the tongue, and a definite, though less conspicuous, appearance of a fringe. Canu and Bassler's pl. xxxvi, fig. 6, differs from their other figures and from all the specimens described above in the wider, shallower sinus of the orifice. It unfortunately does not show the condyles. The Barrier Reef specimen has the same shape of orifice and smooth condyles (Text-fig. 8, A, B). The specimens from Singapore, Amboyna, Clairmont Island and the Holothuria Bank agree with the Barrier Reef colony in these characters. The one from Tahiti has denticulate condyles and a sinus of variable shape, more or less intermediate, between the Barrier Reef and Port Phillip specimens. It has not been possible to detect any differences other than those in the orifice, and the specimens have all been included in *S. schizostoma*. The ovicells have a pair of teeth in the orifice as figured in *S. informata* (*S. spongites*, Smitt) by Levinsen (1909, pl. xviii, fig. 4*b*), and have an ovicellular operculum like that of *S. informata* described below (p. 425). It is not possible to tell from the figures how nearly *S. spongites* var., Hincks (1887, p. 124, pl. xii, figs. 7, 8), is related to *S. schizostoma*.

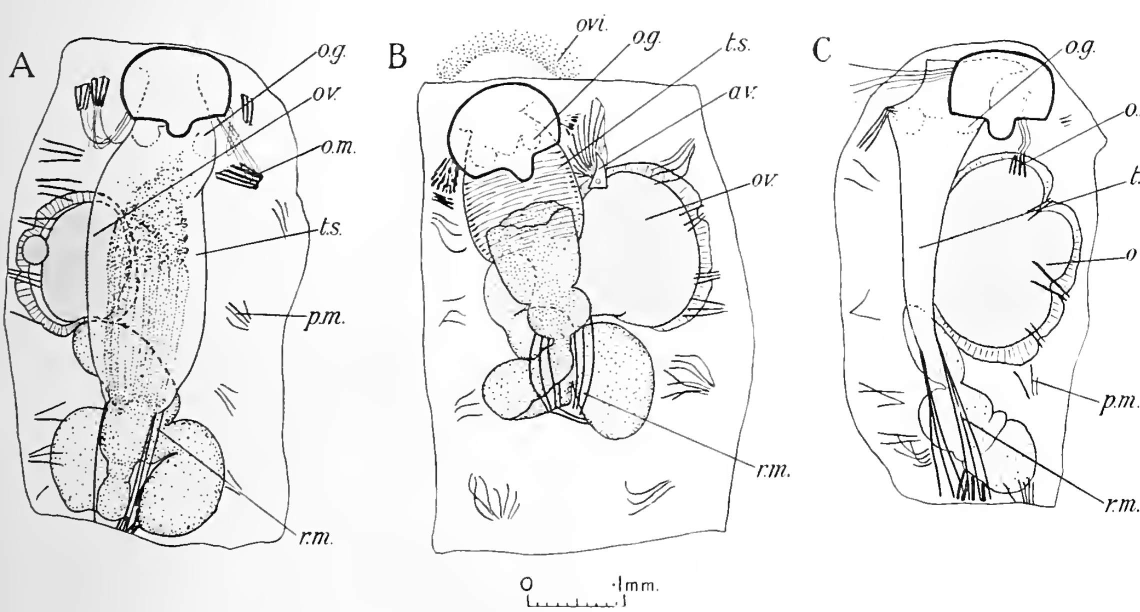
The colony from the Holothuria Bank encrusts the frontal surface of a small Cupularian colony, and on reaching the edge has continued to grow freely in the same direction, producing an irregular flatly conical colony the greater part of which is unattached. A similar colonial form has been observed in specimens of three other Schizoporellid species, two from Tsos Sima, Japan (B.M. 62.7.16.69), and one from the Holothuria Bank (B.M. 92.1.28.76). The latter, which is represented by seven specimens, has a hollow, somewhat hooked calcareous process from the basal wall of each zoöecium. It resembles *S. furcata*, Busk (1884, p. 163),* in most characters, but differs slightly in the shape of the operculum. It is remarkable for possessing vicarious avicularia with a large mandible, strong muscles and complete polypide; similar avicularia have been described in *Cribrilina philomela* by Harmer (1902, p. 293) and in the Anascan genus *Acanthodesia* (Harmer, 1926, pp. 213 *et seq.*; Hastings, 1930*a*, p. 707).† The avicularia of *Crepis decussata*, Harmer (1926, p. 320) also have a polypide.

* Examination of the type-material shows that *S. furcata* and *S. tenuis* (Busk, 1884, pp. 163, 165) are synonyms, having been described from the erect and encrusting parts of the same colony. I have retained the name *S. furcata*. The supposed specimen of *S. tenuis* from Simon's Bay appears to be a specimen of *S. nivea*, as pointed out by Waters (1888, p. 29). It is specifically distinct from the material of *S. tenuis* from Honolulu.

† Superficially similar avicularia have been figured in various species, but their internal structure is unknown, *e.g. Schizoporella cecilii* var., Kirkpatrick (1890*b*, p. 21, pl. v, fig. 8); *Parmularia quadlingi*, Livingstone (1926*a*, p. 86, pl. vi, figs. 1 and 2); *Schizomavella ovoidea*, Canu and Bassler (1929, p. 305, pl. xxxiii, fig. 7).

The ovary can be distinguished in zooecia very near the edge of an actively growing colony of *S. schizostoma* killed on 24th February, 1929. In a longitudinal series the walls of one to three marginal zooecia are being formed, the next zooecium contains a polypide bud, the next a fully formed polypide and in the next a small ovary, consisting of one or more small eggs in a follicle. may be present beside the polypide. The "female polypide" of this zooecium has clearly not been preceded by another polypide as described in the W. Indian species by Canu and Bassler (1923, p. 102; 1928*b*, p. 92). Only one of the ova increases in size, but the others remain visible and may form part of the follicle as described by Calvet (1900, p. 294, pl. ix, fig. 2, various Cheilostomes).

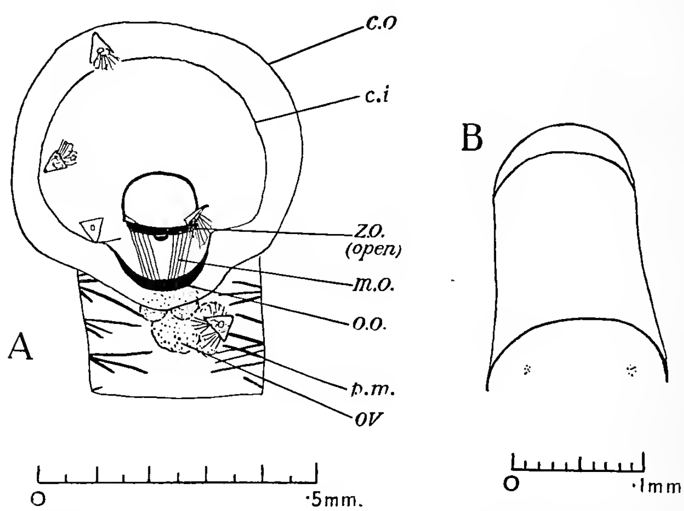
These large ovular cells in the follicle project, on the surface, and are rather conspicuous. The ordinary follicle-cells become columnar, considerably increasing the thickness of the follicle. As in Text-fig. 9, A–C, there may be thin places where the follicle



TEXT-FIG. 9.—*Stylopoma schizostoma* (Macg.). Three stages in the degeneration of the polypide of a fertile zooecium. In C the operculum has been displaced in mounting. *av.*, Avicularium. *o.g.*, Oral gland. *o.m.*, Occlusor muscle. *ov.*, Ovary. *ovi.*, Incipient ovicell. *p.m.*, Parietal muscle. *r.m.*, Retractor muscle. *t.s.*, tentacle sheath.

is pressed against the parietal muscles. When the egg has attained a considerable size the polypide degenerates, the degeneration beginning at the tips of the tentacles (Text-fig. 9, A). Before degeneration the tentacles usually reach the diaphragm. Text-fig. 9, B, shows a stage where the tentacles are reduced to stumps and the tentacle sheath is shortened and thickened. This short-tentacled degenerating polypide is readily distinguished from a polypide-bud with tentacles of the same length by the irregular and confused appearance of the tentacles, which in the bud are clearly defined and deeply staining, by the completeness of the tentacle-sheath, which in the bud is only beginning to be differentiated, and by the relatively large size of the viscera. At this stage the first indication of the ovicell can be detected. It is a curved band of closely placed cells on the frontal wall of the distal zooecium (Text-fig. 9, B). In Text-fig. 9, C, the tentacles have gone and the viscera are dwindling. The arc of ovicell-forming cells is omitted

from this figure. It has become more arched—that is, its median part has advanced distally. There is an indication of the outer capsule outside this cellular band, and both capsules are beginning to grow down beside the orifice. The frontal wall of the ovicell is incomplete. This is the most advanced stage obtained in *S. schizostoma*. It would be interesting to see later stages. The large amount of space occupied by the egg makes the formation of another polypide before the completion of the ovicell very improbable. In the American species Canu and Bassler write of a female polypide without tentacles "which constructs the ovicell." They do not explain in what way such a polypide is supposed to assist in the construction of the ovicell. In *S. schizostoma* the polypide without tentacles is clearly degenerating, and the occurrence of this degeneration when the ovicell is beginning to be formed shows, I think, that in that species the polypide takes no active part in building the ovicell. Doubtless the degeneration of the polypide liberates materials for use in other ways, but there is the increase in size of the egg as well as the construction



TEXT-FIG. 10.—*Stylopoma informata* (Lonsd.) from Galapagos. A, Fertile zooecium and empty ovicell decalcified. B, Ovicellular operculum and tip of zooecial operculum; muscles omitted. *c.i.*, Inner capsule. *c.o.*, Outer capsule. *m.o.*, Muscles of ovicellular operculum. *o.o.*, Ovicellular operculum. *ov.*, Ovary. *p.m.*, Parietal muscle. *z.o.*, Zooecial operculum.

of the ovicell to account for. Little or no trace of oral glands has been detected in the non-fertile zooecia. In the early stages of the fertile zooecia a small protuberance on each side of the diaphragm can usually be detected, and in later stages, such as are figured here, a pair of spherical glands is clearly present.

A few zooecia contain clusters of sperm-forming cells, but spermatozoa are not being developed in any quantity. In a colony of *S. informata* (*S. spongites*, Hastings, 1930*a*, p. 721) collected at the Galapagos Islands on 7th August, 1924, the marginal zooecia contain large quantities of mature sperm, and a small ovary may be present as well. Within this marginal zone many of the zooecia bear fully-formed ovicells, but earlier stages of the fertile zooecia have not been found. The ovicell-bearing zooecia, which all have enlarged parietal muscles and no polypide, are in three states: (1) The ovicell is empty, and a large egg, enclosed in a follicle and accompanied by some small ones, occupies the cavity of the zooecium. (2) There is a large egg or embryo in the ovicell, and in the body-cavity

an ovary consisting of a cluster of eggs, most of which are rather larger than the accessory eggs in state 1. (3) The ovicell is empty and the ovary may be in state 2, or one of the eggs may be enlarged and surrounded by a definite follicle. After decalcification the fully formed ovicell of the Galapagos specimen is seen to consist of a pair of concentric, spherical, membranous capsules (Text-fig. 10, A). The zooecial orifice opens into the ovicell, and to the distal end of its operculum is attached an ovicellular operculum (Text-fig. 10, A, B). This ovicellular operculum is less strongly chitinized than the zooecial operculum; it appears to be continuous laterally with the inner membranous sac, and it is deeply hollowed. A pair of broad muscle-bands run from its distal border and appear to be attached within the zooecial orifice, but the exact point of attachment cannot be made out. Numerous fine muscles radiate from the distal border of the zooecial orifice to the walls of the inner membranous sac. They are so numerous and so fine that they have been omitted from the figure. It will be noticed that the avicularium buried beneath the ovicell has lost its musculature. Those with muscles are on the surface of the ovicell.

A specimen from the Providence Reef, Mascarene Islands (B.M. 82.10.18.48) appears to be the form obtained from the Gulf of Manaar by Waters (1918*a*, p. 17). The orifice (Text-fig. 8, L) has a knob-like tooth on each side of the sinus, and the sockets in the operculum to which these teeth articulate are conspicuous. The operculum (Text-fig. 8, K) resembles that of the genotype in having a disc-like tip to the tongue, but both tongue and tip are narrower and the operculum is uniformly curved in outline, not wider proximally. The orifice of the ovicell is traversed by a calcareous bar, occupying the position of the teeth in most other species. The ovicell thus has two orifices and resembles that of *S. viride*, in which, however, the bar is broader, and the ovicell being flatter the orifices are directed proximally instead of obliquely towards the frontal wall of the fertile zooecium. As suggested by Canu and Bassler (1928*b*, p. 92) this appears to be a distinct species.

Stylopoma viride (Thornely). (Text-fig. 8, M.)

Schizoporella viridis, Thornely, 1905, p. 116, pl. i, fig. 3; 1912, p. 148; Waters, 1909, p. 147, pl. xiii, figs. 1–8; 1918*a*, pl. ii, fig. 18; Marcus, 1921*b*, p. 17; Livingstone, 1926*a*, pl. viii, fig. 10.
Stylopoma grandis, Canu and Bassler, 1929, p. 316, pl. xxxvii, figs. 1–3.

Occurrence.—Batt Reef; Low Is. (shore).

Distribution.—New Guinea, Aru Islands, Philippine Islands, Indian Ocean, Red Sea.

There can be no doubt that these specimens belong to Thornely's species, with which they agree very exactly. The pieces of Thornely's specimen in the British Museum (06.12.3.10) and the Manchester Museum (Waters Collection) are both without ovicells, but one is shown by Thornely (1905, pl. i, fig. 3) and agrees with those of the Barrier Reef specimen. The separation of the transverse oval orifice of the ovicell from the zooecial orifice, as shown in this figure, is mentioned by Waters and Marcus. This is all that can be seen in direct frontal view, but, by tilting the Barrier Reef specimens, a slit can be seen between the proximal edge of the ovicell and the frontal wall of the zooecium. The sinus of the zooecial orifice can be seen through this aperture. The zooecial operculum bears an ovicellular operculum as in the other species of *Stylopoma* described above. On many of the ovicells of the Barrier Reef specimens of *S. viride* there is a small pointed avicularium, directed outwards on each side of the oval distal aperture, and there may be small ones on humps on the distal circumference of the ovicell.

The elongated, adventitious avicularium on the distal side of the orifice (Thornely, 1905, pl. i, fig. 3 ; 1912, p. 148) may be present on nearly every zooecium of the single regular layer at the edge of the colony. It may be transverse as shown, or placed beside the orifice, pointing obliquely towards the distal end of the zooecium. Its mandible, like that of the vicarious avicularium, has a triangular base and a long, laterally compressed, knife-like rhachis. The small avicularium below the orifice may be present on the same zooecium as the large distal one.

The Mediterranean specimen which Waters (1909, p. 147) identified with *S. viride* is superficially very similar, but it has markedly different opercula and mandibles and is clearly a distinct species. Busk's manuscript name for it, published by Waters, remains a *nomen nudum*.

S. grande, Canu and Bassler (1929), is clearly a synonym of *S. viride* (Thornely). It agrees in the shape of the orifice, in the form of the adventitious and vicarious avicularia, in the ovicells, in the plurilamellar colony and the green colour.

Livingstone (1926*a*, p. 84) described a variety of *S. viride* with blunt vicarious avicularia which was obtained on the Barrier Reef. This variety is not represented in the present collection. While fully recognizing their distinctness, Livingstone compared some characters of this variety to *Schizoporella ampla*, Kirkpatrick (1888*a*, p. 76). It may be worth recording that I have examined the type of *S. ampla*, and confirmed the accuracy of Kirkpatrick's description and figures. The comparatively small ovicell, which does not cover the orifice, will, if *Stylopoma* is found to be a good genus, distinguish *S. ampla* and *S. viride* generically.

Hippothoa distans, Macgillivray.

Hippothoa distans, MacGillivray, 1869, p. 130 ; Waters, 1904, p. 54, pl. iii, figs. 8*a–g* (references).
Hippothoa flagellum, Canu and Bassler, 1929, p. 247, p. xxii, fig. 7.

Occurrence.—St. XII.

Distribution.—Australia, New Zealand, Malaya, Indian Ocean, European Seas, Atlantic, Antarctic, Queen Charlotte Island.

This specimen, like that of Canu and Bassler, has the ovicell-bearing cells of approximately the same size as the rest. A specimen from Port Phillip (B.M. 97.5.1.788) agrees with Waters's figure in having small ovicelligerous cells.

Mastigophora pesanseris (Smitt).

Hippothoa pes anseris, Smitt, 1873, p. 43, pl. vii, figs. 159, 160.
Mastigophora pesanseris, Osburn, 1927, p. 130 ; Canu and Bassler, 1929, p. 412, pl. lviii, figs. 4–8 (references).
Mastigophora pes-anseris, Hastings, 1930*a*, p. 722.

Occurrence.—N.E. Low Is.

Distribution.—Philippines, Hawai, Indian Ocean, Madeira, Brazil, Florida, Panama.

Trypostega venusta (Norman).

Lepralia venusta, Norman, 1864, p. 84, pl. x, figs. 2, 3.
Trypostega venusta, Livingstone, 1927, p. 58 ; Canu and Bassler, 1929, p. 248, pl. xxii, figs. 9–11 ; Hastings, 1930*a*, p. 720 (references).

Occurrence.—St. XIII.

Distribution.—Queensland ; Philippines ; China Sea ; Jicaron Island, Panama ; Indian Ocean ; Atlantic ; English Channel.

Microporella ciliata (Pallas).

Eschara ciliata, Pallas, 1766, p. 38.
Microporella ciliata, Maplestone, 1909, p. 268; Osburn, 1927, p. 129; Canu and Bassler, 1929, p. 331, pl. xl, figs. 2–4; Hastings, 1930*a*, p. 727 (references).

OCCURRENCE.—St. XIII, XXI.

DISTRIBUTION.—Cosmopolitan.

The specimen from St. XIII is a small colony of the typical form, and has very thin walls and somewhat elongate avicularia. That from St. XXI is of the personate type.

Microporella malusii (Aud.).

Cellepora malusii, Audouin, 1826, p. 239; Savigny, pl. viii, figs. 8^1, 8^2.
Microporella malusii, Waters, 1887, p. 188; Kirkpatrick, 1890*a*, p. 612; Macgillivray, 1890*c*, p. 4; Marcus, 1921*c*, p. 108, pl. v, fig. 8; 1921*d*, p. 107, text-fig. 9; Livingstone, 1926*a*, p. 98; 1927, p. 62.
Fenestrulina malusii, Canu and Bassler, 1923, p. 115, pl. xxxvi, figs. 2, 3 (literature); Livingstone, 1929, p. 89.

OCCURRENCE.—St. XII.

DISTRIBUTION.—Cosmopolitan.

Another Australian form allied to *M. malusii* is represented in the British Museum (97.5.1.677 and 679) by specimens from Port Phillip and in the Cambridge Museum by some from Port Jackson. The ovicells are deeply immersed in the distal zooecium, so that they hardly project frontally, although all the parts of the ovicell of typical *M. malusii* can be recognized in them.

Microporella mutabilis, sp. n. (Plate I, fig. D; Text-fig. 11.)

Microporella malusii, Haswell, 1881, p. 38; Livingstone, 1926*a*, p. 98.
? *Microporella malusii*, Thornely, 1912, p. 146, pl. viii, fig. 8.

OCCURRENCE.—St. XII.

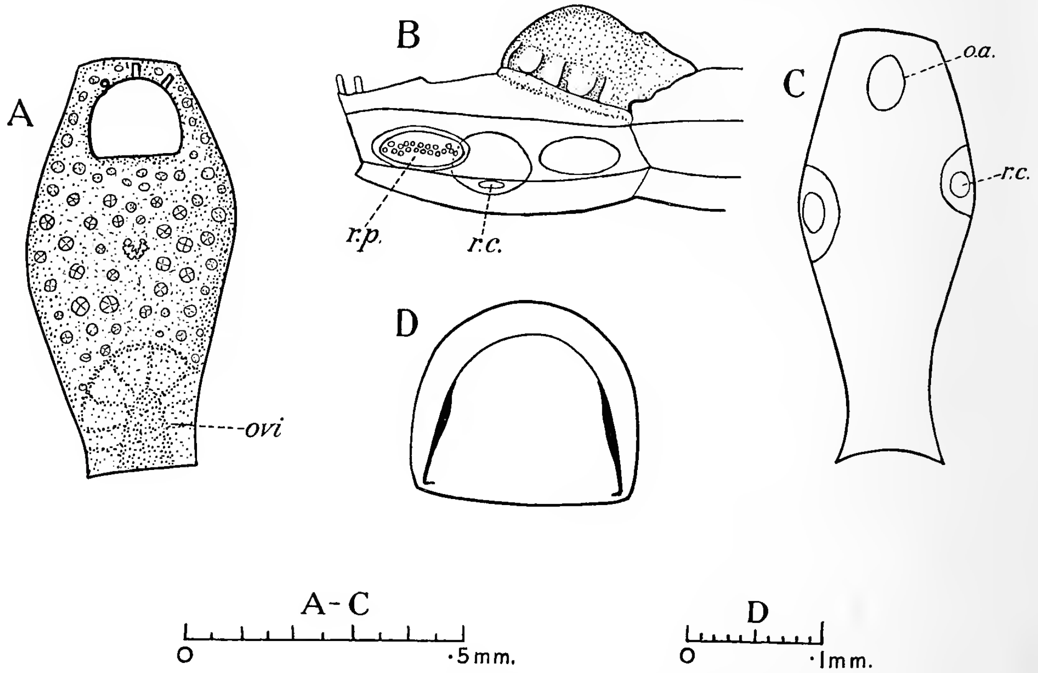
DISTRIBUTION.—Great Barrier Reef, Port Denison.

TYPE.—St. XII (B.M. 32.4.20.50).

DESCRIPTION.—In *M. malusii* the colony is encrusting, the zooecia are not much longer than wide, and the frontal wall has an imperforate area behind the ascopore, the stellate, frontal pores being more or less marginal. There are three long, narrow pore-chambers, one distal and one on the distal half of each lateral wall. In the type-specimen of *M. mutabilis* the colony is hemescharan (Plate I, fig. D), and has a flustrine appearance (*cf.* Livingstone, 1926). Its basal surface is covered throughout by a thin layer of a sponge, *Oscarella tenuis*, Hentschel, but the hemescharan form is not due to this, for a hemescharan specimen from Port Denison is quite free from sponge, and Mr. Livingstone informs me that none of his specimens bear any such growth. The stellate pores are uniformly distributed over the frontal surface, and the zooecia are usually considerably longer than broad (Text-fig. 11, A). The orifice is approximately the same size as in *M. malusii*, but may be a little longer in proportion to its width. The operculum (Text-fig. 11, D) is essentially similar, but the sclerite is a little further from the margin. There may be two to four spines on the distal border of the orifice. The sponge can be readily peeled off, and the basal surface is then found to differ from that of *M. malusii*. In the majority of the zooecia no pore-chambers are visible, and it seems that they really are absent, their places being taken by three multiporous rosette-plates, each occupying the elongate, oval area of the lateral or distal wall against which the pore-chamber is found

in *M. malusii.* The basal wall (Text-fig. 11, c) has an oval, uncalcified area of variable size in its distal part, and on each side a chamber from which a rootlet may spring. The rootlet chamber resembles a pore-chamber in occupying the angle between the basal and lateral walls, and being cut off from the body-cavity by an oblique wall. This wall bears a group of pores. The chamber is placed proximally to the rosette-plate and very close to it (Text-fig. 11, B). The rootlet-chambers and oval area are not found on all the zooecia, and one, two or three pore-chambers may be present.

On the cruise of H.M.S. " Alert " escharan as well as hemescharan specimens of this species were obtained from 3–4 fath. off Port Denison (B.M. 81.10.21.23, 82.2.23.89). No exact locality is given for a loosely encrusting colony obtained on the same cruise (B.M. 81.10.21.355). These specimens agree with the Barrier Reef specimen in their



TEXT-FIG. 11.—*Microporella mutabilis*, sp. n. A, Frontal view. B, Side view. C, Basal view. D, Operculum. *ovi.*, Incipient ovicell of proximal zooecium. *o.a.*, Oval area. *r.c.*, Rootlet-chamber. *r.p.*, Rosette-plate.

large zooecia, and large, evenly distributed pores. The distribution of pore-chambers, rootlet-chambers and oval areas is most erratic. In the hemescharan specimen the majority of the zooecia have the oval area present and pore-chambers absent, but the oval area may be absent and one or more pore-chambers may be present. Rootlet chambers were not found. The two layers of the escharan specimen are readily separable, and between them is a thin layer of material which contains some spicules and may be a sponge. Neither oval areas nor rootlet chambers were seen and pore-chambers are very irregularly distributed, many zooecia having none, others one, two or three. The loosely encrusting specimen agrees with the type in having an oval area, rootlet-chambers and no pore-chambers in the majority of its zooecia and it shows similar variability. There may be two rootlet-chambers on the same side of the zooecium, one occupying the distal corner.

Occasionally, notably in the material from Port Denison in the Cambridge Museum, there is a pair of small lateral oval areas in the basal wall, marking the attachment of the occlusor muscles of the operculum.

To sum up, this species is distinguished from *M. malusii* by the larger size of its zooecia, by the uniform distribution of the pores, by the absence of pore-chambers in some zooecia and by slight differences in the orifice and operculum. The colony may be escharan, hemescharan or loosely encrusting. The oval area and rootlet-chambers are not invariably developed, but they are very distinctive when present. *M. malusii* and *M. mutabilis* were both obtained at the same station in 10–15½ fath.

REMARKS.—Part of the material from Port Denison identified by Haswell (1881, p. 38) with *M. malusii* is in the Cambridge Museum and belongs to *M. mutabilis*. *M. malusii*, Thornely (1912), from the Indian Ocean, agrees with *M. mutabilis* in its large zooecia and uniformly distributed pores, but no ribs are described or figured round the ovicell.

A loosely encrusting specimen, collected by Darwin at the E. Falkland Islands (B.M. 99.7.1.2668), seems to be nearer to *M. mutabilis* than to *M. malusii*, though distinct from both. It agrees with *M. mutabilis* in its large zooecia and pores, in the presence of an oval area in the basal wall and in the absence of pore-chambers. There are no rootlet chambers. It has a small area free from pores behind the ascopore, thus approaching *M. malusii*. The ends of the sclerite of the operculum turn slightly outwards, and show no trace of the little sclerite projecting at right angles that is found in *M. malusii* and *M. mutabilis*. The orifice is considerably larger than in *M. malusii*, and the ovicell may bear fine radiating striations. Similar specimens were obtained by the "Challenger" from the Falkland Islands, and by Jullien (1888, p. 38) and Darwin at Tierra del Fuego. The latter material is figured by Busk (1854, pl. ciii, figs. 1–3), who mentions the large size of the zooecia compared with the European form. The "central flattened disc" is evidently the oval area. It is of similar size in the Falkland Island specimen. It appears rather different from that of *M. mutabilis* owing to its large size, but there is considerable variation in this respect in the hemescharan specimen from Port Denison, some being as large as those from the Falkland Islands. The ancestrula is included in two of Darwin's specimens, and the surrounding zooecia are of the thyreophora-form. The ancestrula is membraniporine and has spines all round the opesia. Waters (1904, p. 42) records specimens of the thyreophora-form from Chili, with large zooecia and apertures, which may be the same species.

Canu and Bassler (1928*a*, p. 84) described *Fenestrulina ampla*, a large species from Brazil, which differs from Darwin's species in its small circular ascopore, thick border to the operculum and rather smaller orifice. The average of a number of measurements of the orifices of Darwin's species exceeds the maximum given by Canu and Bassler for *F. ampla*.

Smittina signata (Waters). (Text-fig. 12 D, E.)

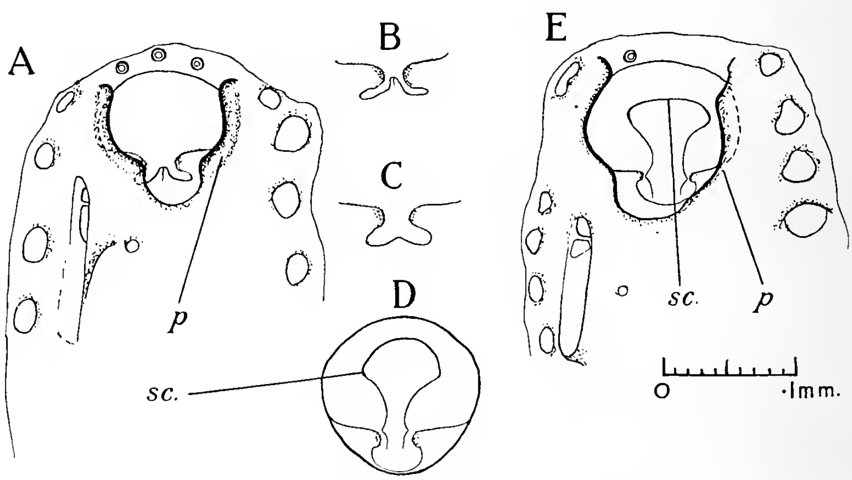
Smittia signata, Waters, 1889, p. 17, pl. iii, figs. 4–6; Thornely, 1912, p. 151.
Lacerna signata, Canu and Bassler, 1929, p. 308, pl. xlii, figs. 10, 11, text-fig. 131C (not D).

OCCURRENCE.—N.E. Low Is.; St. XXII.

DISTRIBUTION.—New South Wales, Indian Ocean, Philippines, Tahiti (Crossland Coll., B.M. 29.4.25.2 and 3).

These small encrusting colonies agree very closely with Waters's type-specimen. The sclerites of the operculum (Text-fig. 12, D, E) are more bowed, but, as the figures show, there is some variation in their shape. The peristome may be less developed, or may be continued round the distal border of the orifice. The ligulate avicularia vary in size, and may be only half the length of that figured. The large, spatulate avicularia are more numerous towards the centre of the colony. The spines are rarely visible, their stumps apparently becoming buried in a calcareous crust.

The specimens of Canu and Bassler (1929) from the Philippines appear to differ in the triangular shape of the sclerite of the operculum, but under a low magnification the more constricted sclerites of the Barrier Reef material may give this impression. The Barrier Reef specimens agree in size with those from the Philippines, the orifices being slightly larger than in the type. In some fragments from Okinose, off Tokyo, in the Cambridge



Text-fig. 12.—A–C, *Smittina*, sp., from the Tizard Bank. D, E, *Smittana signata* (Waters). A, Distal part of a zooecium. B, C, Lyrula and condyles. D, Orifice and operculum. E, Distal part of a zooecium. *p.*, Peristome. *sc.*, Sclerite.

Museum, the zooecia and orifices are even larger (diameter of orifice ·13–·15 mm.). In this Japanese material the denticulation extends along the distal border of the condyle, as in *Smittina* sp. (Text-fig. 12, A–C) from the Tizard Bank, described below.

Canu and Bassler put *S. signata* in *Lacerna*, Jullien (1888, p. 48), but according to Waters (1904, p. 51) the genotype, *L. hosteensis*, has a schizoporellid operculum. *S. signata* differs from the typical species of *Smittina* chiefly in the absence of a median tooth or lyrula, and at present I see no need to separate it, more especially as a very similar species from the Tizard Bank (B.M. 89.8.21.17b) has a pointed tooth of variable size in the position of the lyrula (Text-fig. 12, A–C). The specimen is unfortunately very small and without opercula. The peristome, the denticulate condyles and the spatulate and ligulate avicularia are very much like those of *S. signata*, but the denticulation extends along the distal border of the condyle as in the Japanese specimen described above.

Schizopodrella horsti, Osburn (1927, p. 127), appears to be another *Smittina*-like species with no lyrula. The operculum is described as slightly chitinized and is presumably without the sclerites of *S. signata*.

The species from the Red Sea, identified by Waters (1909, p. 157, pl. xiii, fig. 9) with *S. marmorea*, appears to be more nearly related to *S. signata*, but its operculum is unknown.

Smittina obstructa (Waters).

Smittia obstructa. Waters, 1889, p. 18, pl. iii, figs. 7, 8.

Occurrence.—Batt Reef.

Distribution.—New South Wales.

This specimen agrees closely with Waters's, but has no ovicells. The operculum is of characteristic form, but slightly less chitinized. The peristome is prominent laterally, though not quite so markedly so as in Waters's specimen, and frequently has an avicularium "leaning against the prominence." There are small blunt avicularia on the frontal wall of some zooecia and some very large spatulate ones. In this specimen, unlike that described by Waters, the large spatulate avicularia are not vicarious, but are on the frontal wall, with their proximal end beside the orifice of the zooecium. The only one visible on the specimen from the Waters Collection lent to me is, however, similar, though the orifice of the zooecium can only be discerned clearly when the specimen is wet. In form and position the spatulate avicularia resemble those of *S. trispinosa* var. *inaequalis* (Waters, 1879, p. 41), and superficially the specimen might be taken for that form, especially as a Neapolitan specimen of the latter presented by Mr. Waters (B.M. 79.4.25.25) has a pointed avicularium beside the peristome of some zooecia. The two forms are clearly distinguished by their opercula.

Smittina acaroensis, Levinsen.

Smittina acaroensis, Levinsen, 1909, p. 342, pl. xviii, figs. 12*a*, *b* (*S. akaroensis* in description of plate).

Occurrence.—St. IX, XII.

Distribution.—New Zealand, Bass Strait (B.M. 99.5.1.1127).

These two young colonies do not show the extreme development of the ribs between the areolae described by Levinsen. The spines vary from 4 to 6, and the areolae do not form such a definite border to the ovicell. Otherwise the agreement with Levinsen's description is very close. The material is insufficient for examination of the rosette-plates. The mandible is semicircular, with two oblique sclerites. Older colonies from New Zealand in the British Museum show advanced calcification as described by Levinsen. In the specimen from Bass Strait the avicularia vary in size.

S. acaroensis is very closely allied to the areolated type of *S. landsborovii* shown by Hincks (1880, pl. xlviii, fig. 7). The specimens of *S. acaroensis* in the Hincks and Wilson Collections in the British Museum are labelled "*S. landsborovii* ?" and it seems possible that some of the published records of *S. landsborovii* in the Australian and Indo-Pacific regions may be based on this species.

Phylactella geometrica, Kirkpatrick.

Phylactella geometrica, Kirkpatrick, 1890*b*, p. 20, pl. v, figs. 7–7*c*.

Occurrence.—St. II.

Distribution.—China Sea.

Cigclisula. (Text-fig. 13.)

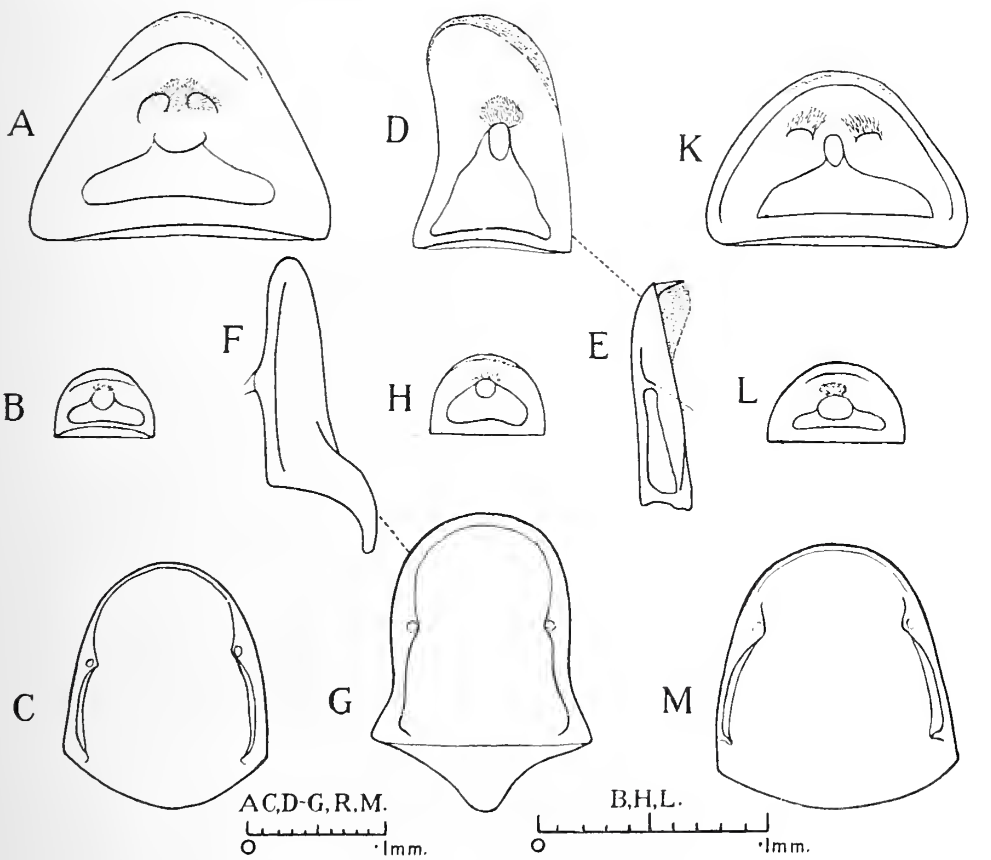
Escharoides occlusa, Busk (1884, p. 150) has been referred to the following other genera: *Lepralia* (by Waters, 1888, p. 26), *Myriozoum* (by Levinsen, 1909, p. 301, and Marcus, 1921*a*, p. 20; 1922, p. 435), *Cigclisula* (by Canu and Bassler, 1927*a*, p. 6). Livingstone (1926*a*, p. 91) puts the closely allied form *C. areolata* (Kirkpatrick, 1890*a*, p. 618) in *Porella*. Although retained provisionally by Marcus, I think the attribution to *Myriozoum* can be dismissed at once for the reasons given by Waters (1913, p. 519). *Escharoides*, Milne-Edwards (1836, p. 259), is almost unanimously abandoned owing to difficulties about the genotype which need not be recounted here. Strictly according to the rules *Lepralia* is a synonym of *Escharoides*, but Norman (1903, p. 99) and Lang (1917, p. 171) retain it with *Lepralia nitida* (Fleming) as genotype. In either case the name is not available for *E. occlusa*, which differs in its orifice from *L. nitida*, and from all the other species included in *Lepralia* by Johnston. *Porella* was introduced by Gray (1848, p. 127) for *Millepora cervicornis*, Solander (1786, p. 134), *M. compressa*, Sowerby (1805, p. 83), being given as a synonym. These two species are distinct, and Norman (1903, p. 112) selected *M. compressa* as the genotype of *Porella*. This selection has priority over that of *M. cervicornis* by Canu and Bassler (1917, p. 54). *Cigclisula* was introduced by Canu and Bassler (1927*a*, p. 6) with *E. occlusa* as genotype.

The choice of genus for *E. occlusa* thus lies between *Porella* and *Cigclisula*, but before their claims can be considered the characters of *E. occlusa* must be defined a little more closely.

Marcus (1921*a*, pl. i, fig. 8) figured an operculum shaped to fit an orifice with a definite sinus. He assumed some inaccuracy in Waters's figure (1888, pl. iii, fig. 32) of an operculum from the type-specimen from Samboangan. Waters's is an accurate picture of some opercula. Others on the same slide are longer, like those of Canu and Bassler (1929, p. 292, text-fig. 122, C, D), but none approach the type of operculum figured by Marcus. Such an operculum is, however, found in three specimens in the British Museum (B.M. 92.1.28. 71A and 72, 86.2.19.9), all from W. or N.W. Australia, which is the region from which Marcus obtained his first material (Text-figs. 13, F, G). His specimens from the Aru Is. (1922, p. 435) were apparently of the same type. The two forms agree closely except for the remarkable difference in the orifice, and more or less intermediate specimens are found (B.M. 92.4.14.4, 51.11.14.75).

The type of *E. occlusa* resembles *P. compressa* and the species associated with it in many ways. They agree in the more or less semicircular primary orifice, with rounded corners, the thickening of the frontal wall and the formation of a peristome with an avicularium in its proximal wall. The formation of the ovicell seems to be similar, though the incomplete frontal calcification of that of *E. occlusa* gives it a superficially different appearance. There are some differences, however, that may be more important. Oblique sclerites are not a conspicuous feature of the mandibles of *E. occlusa*, and the oral glands form a large and rather complex median structure (Waters, 1909, p. 152). *P. compressa* has paired glands of ordinary size and shape. In *P. compressa* the formation of the peristome and avicularium is accompanied by a thickening and straightening of the proximal lip of the primary orifice, almost amounting to the formation of a broad shallow lyrula, though a lyrula is usually stated to be absent in *Porella*. In *E. occlusa* the proximal edge is more concave and remains so. In *P. compressa* and most if not all

undoubted species of *Porella* the peristomial avicularium is median and directed frontally; in *E. occlusa* it is lateral and directed obliquely. If *E. occlusa* were the only species of its kind the differences enumerated above would hardly justify its separation from *Porella*, but the existence of several species allied to *E. occlusa*, and differing from true *Porella* in most if not all these ways (the oral glands of some are not known), supports the view that *E. occlusa* deserves generic rank. Besides the two species recorded in this paper, *Porella fissurata*, Ortmann (see Livingstone, 1926*a*, p. 92), and *Cellepora verticalis*, Maplestone (1910, p. 39), appear to be congeneric with *E. occlusa*. A topotype of *C.*



TEXT-FIG. 13.—A–C, *Cigclisula cautium*, sp. n. D–H, *C. occlusa* from the Holothuria Bank, "Marcus's form." K–M, *C. verticalis* (Maplest.). A, Mandible of large oral avicularium of marginal zooecium. B, Mandible of small oral avicularium. C, Operculum. D, E, Mandible of large oral avicularium, slightly oblique and lateral views. F, G, Operculum, frontal and lateral views. H, Mandible of small oral avicularium. K, L, Mandible of large and small oral avicularia. M, Operculum.

verticalis (B.M. 10.9.19.1) agrees with *E. occlusa* in the general form of the primary orifice and operculum (Text-fig. 13, M), in the very extensive secondary calcification, in the position of the avicularium in the peristome, in the structure of the avicularian mandibles (Text-fig. 13, K, L), and in the ovicell with a frontal fissure. It differs in the wider, less shaft-like peristome, in which the avicularium remains clearly visible, in the form of the colony and in the absence of vicarious avicularia. I have accepted *Cigclisula* for this group of species, and would distinguish it from *Porella* by the fissured ovicell, lateral and oblique peristomial avicularium, and possibly the large median gland. The definition

of Canu and Bassler must be modified to admit forms with a simply fissured ovicell and a frontal wall with either pores or areolae. *Porina serrulata*, Smitt (1873, p. 27), was included in this genus by Canu and Bassler (1928*b*, p. 125), but is omitted here because of its median pore. It also differs in the position of the peristomial avicularium.

In *C. verticalis* the basal parts of the escharan colony become thickened by the development of superficial layers of zooecia. It is interesting to compare the method in *C. occlusa*, where superficial layers are not formed to any marked extent, but the old zooecia at the base of the colony are converted into kenozooecia. This takes place by great thickening of their calcareous walls and closure of the orifice as described by Busk (1884, p. 150). In some specimens, *e. g.* that from Albany Passage, Torres Straits (B.M. 90.3.24.51), this formation of kenozooecia may take place in stages. First there is a great deposition of calcareous matter and the orifice becomes smaller. Then an avicularium is formed over the orifice with its mandible directed backwards. The mandible resembles those of the vicarious avicularia in shape, but is smaller. It is also distinguished by its direction, those formed at the growing edge in the ordinary way pointing forward (Canu and Bassler, 1929, p. 291). As calcification proceeds a film of calcareous matter spreads over the avicularium and it finally becomes buried. Thus the ultimate appearance of the kenozooecia is the same whether an intermediate avicularian stage occurs or not. This forms an interesting parallel to the processes of secondary thickening in the Reteporidae described by Buchner (1924, p. 173, etc.), in which the avicularia play an important part.

Cigclisula areolata (Kirkpatrick).

Lepralia occlusa, var. *areolata*, Kirkpatrick, 1890, p. 618, pl. xvi, figs. 7, 7*a*.
Porella areolata (encrusting specimens), Livingstone, 1926*a*, p. 91, pl. viii, fig. 4 ; 1927, p. 64.
Not *Porella areolata*, Ortmann, 1889, p. 42.

Occurrence.—Batt Reef.

Distribution.—Torres Straits, Barrier Reef.

There is a circular encrusting colony of this form, with a second layer of zooecia forming at the centre. The type-specimens are encrusting and several layers thick. Livingstone records both encrusting and erect forms from the Barrier Reef, but there is evidence, as explained below under *C. cautium*, that his erect specimens belonged to that species. Spatulate avicularia are present as they are in the type, though not mentioned by Kirkpatrick, and in Livingstone's specimens. Spirit material for the examination of the oral glands has not been available.

The primary orifice of *C. areolata* is broader in proportion to its height and rounder than that of *C. occlusa*. At first the frontal wall is uniformly punctured as in *C. occlusa*, but with increased calcification it develops marginal areolae and an imperforate central area. In the specimens examined by me the beak of the vicarious avicularium of *C. areolata* has straight sides converging towards the hinge, and that of *C. occlusa* has curved sides with the narrowest part a little distal to the hinge. The mandible has this curved outline in both species.

Ortmann (1889, p. 42) introduced the name *Porella areolata* independently for a species unconnected with the present group. This would have priority if the genus *Cigclisula* were to be merged in *Porella*, but at present there is no need to suppress Kirkpatrick's name.

Livingstone (1926*b*, p. 247) recorded, as *Porella*. sp., a colony from the Capricorn Group, and described it as "closely allied to *Porella areolata*" and with characters "somewhat in accordance with *Mucronella mentalis*, Macgillivray" (1890*a*, p. 109). Its position remains uncertain.

Cigclisula cautium, sp. n. (Text-fig. 13, A–C.)

Porella areolata (erect specimens), Livingstone, 1926*a*, p. 91, pl. viii, figs. 2, 3.

Occurrence.—St. XIV.

Distribution.—Barrier Reef; Tsos Sima, Japan (B.M. 62.7.16.76).

Holotype.—St. XIV (B.M. 32.4.20.54).

Description.—The colonies consist of flattened branches that are narrower than those of most specimens of *C. occlusa*. The zooecia are longer than those of *C. occlusa*. The frontal wall from its first formation has marginal areolations and has its central part imperforate or with two or three pores, as in Livingstone's pl. viii, fig. 2. With increased calcification irregular lumps and processes are formed. As in *C. occlusa*, the orifice is variable in length, but it is usually longer and its proximal border is straighter than that of *C. occlusa* (Text-fig. 13, C). The mandibles of the peristomial avicularia (Text-fig. 13, B) are of the same type as those of *C. occlusa* and *C. areolata*, but those on the marginal zooecia are often large and triangular (Text-fig. 13, A) and placed in a plane perpendicular to the frontal surface, in such a way as to be conspicuous even in heavily calcified zooecia. The vicarious avicularia are long and rather slender, and small round avicularia occur sporadically on the frontal surface. The ovicells resemble those of *C. occlusa*, and the oral glands are of the peculiar type described in that species by Waters (1909, p. 152).

Remarks.—This species is distinguished from *C. areolata* by the absence of a uniformly perforate stage in the formation of the frontal wall, by the greater average length of the opercula, by the large, triangular, peristomial avicularia on some marginal zooecia, by the long slender vicarious avicularia with curved sides to the beak, and possibly by the erect branching form of the colony. It is distinguished from *C. occlusa* by the areolated frontal wall, the straighter proximal edge of the orifice and the large triangular avicularia. The oral avicularia of *C. occlusa* may be much enlarged, but these large avicularia do not occur specially on the marginal zooecia, they overhang the orifice and the mandible is spatulate (Text-figs. 13, D, E).

Livingstone does not state whether his figures were made from erect or encrusting specimens, but as figs. 2 and 3 agree with the present form, it may be surmised that they were made from erect ones. Fig. 4, on the other hand, agrees with the encrusting form, to which the name *C. areolata* is here restricted. It does not follow that all Livingstone's erect specimens belonged to *C. cautium*, but it seems probable.

Petraliidae.

A start has been made with sorting the Petraliidae into genera by the introduction of *Petraliella* and *Coleopora* by Canu and Bassler (1927*a*, pp. 5, 6). According to the usage of Canu and Bassler (1929, p. 255), all the Barrier Reef species would be placed in *Petraliella*, but as I am not satisfied that any of them is specially related to *P. bisinuata* (Smitt,

1873, p. 59), the genotype, I prefer to put them in *Petralia*, Macgillivray (1868, p. 141*), used in the old, wide sense.

Petralia chuakensis, Waters.

Petralia chuakensis, Waters, 1913, p. 518, pl. lxx, figs. 10–14 ; Livingstone, 1926*a*, p. 99.
Petrialella chuakensis, Canu and Bassler, 1929, pp. 251, 256, text-figs. 103F, 106B.

OCCURRENCE.—Low Isles (shore).

DISTRIBUTION.—Zanzibar, Torres Straits.

These specimens agree very closely with Waters's description and specimens. The only difference detected is that, instead of one large perforated area on the dorsal surface, there are a number of smaller ones, the largest usually being median and distal.

Mr. Livingstone points out that these specimens come from a muddy habitat similar to that of the ones recorded by him from Torres Straits.

Petralia vultur var. *serrata*, Livingstone. (Text-fig. 14.)

Petralia vultur var. *serrata*, Livingstone, 1926*a*, p. 95, pl. vi, figs. 7–10 ; 1927, p. 66.
Mucronella magnifica, Kirkpatrick, 1890*a*, p. 612.
Mucronella vultur, Thornely, 1905, p. 124.
? *Petralia aviculifera*, Marcus, 1922, p. 441, pl. xxv, figs. 12*a–f*.

OCCURRENCE.—W. Low Is., 6 fath. ; St. XII.

DISTRIBUTION.—Ceylon ; Barrier Reef ; Murray Island, Torres Straits ; Fitzroy Island, Queensland (B.M. 81.10.21.72) ; Holothuria Bank, N.W. Australia, 24–34 fath. (B.M. 92.1.28.68).

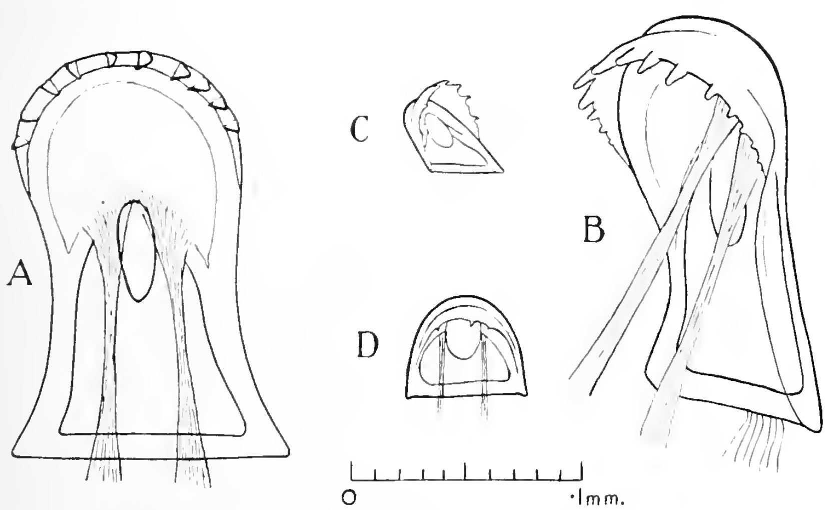
P. vultur var. *armata*, Waters (1913, p. 518) is described as having a pointed avicularium on the mucro, thus differing from Livingstone's varieties *serrata* and *bennetti*. Examining Waters's specimens I find, however, that the oral avicularia of var. *armata* are blunt with a toothed terminal flange, agreeing with his figure rather than his description. Seen obliquely under a low magnification, the flange gives the mandible the appearance of having a pointed, down-turned tip. A specimen of var. *serrata* from Peak Point (B.M. 31.10.12.6) sent by the Australian Museum has a few small round avicularia on the frontal wall, though not as many as in var. *armata*, and in the Barrier Reef specimens, which have all the types of avicularia, described in var. *serrata* by Livingstone, the small frontal avicularia are as numerous as in var. *armata*. Var. *serrata* is thus only distinguished by the presence of the long frontal avicularium. The Barrier Reef specimens differ slightly from both varieties in the orifice, which is wider than high, and has a wide median denticle.

Possibly these varieties should be regarded as specifically distinct from *P. vultur* (Hincks, 1882, p. 167, pl. viii, fig. 2), in which the avicularium on the mucro is fully visible in frontal view instead of being lateral, and the mandible ends in a down-turned point instead of being blunt with a toothed flange. A specimen from Port Phillip (B.M. 88.11.14.349) shows both these characteristics clearly.

* Canu and Bassler (1929, p. 253) give the date of the introduction of *Petralia* as 1887. This is the date of the 'Catalogue of Marine Polyzoa,' in which MacGillivray (1887*b*, p. 212) gives a slightly enlarged definition of the genus. It is not only antedated by the original introduction (1868, p. 141), but also by the slightly modified repetition of this definition in McCoy's Prodromus (MacGillivray, 1881, p. 45). In all three works it comprises the single species *P. undata*. The selection of *P. japonica* as genotype by Canu and Bassler (1929, p. 253) is therefore invalid. Waters (1925, p. 541) recognized *P. undata* as the type.

The mandible of the small frontal avicularia resembles that of the oral ones in structure, having a pair of oblique sclerites passing from the lateral edges to the distal end of the lucida and having a toothed flange (Text-fig. 14, C. D). As in Livingstone's figure, the mandibles of the large spatulate frontal avicularia are untoothed, and have a median longitudinal sclerite meeting the two oblique sclerites. The edge of the concave part of the side is very finely beaded. *cf. P. chuakensis*, Waters (1913, pl. lxx, fig. 13). The oral mandibles (Text-fig. 14, A, B) have one of the lateral edges turned in and bordered by a sclerite. The opposite edge was never seen to be bent, and it appears that the mandibles are asymmetrical in this respect. The musculature is strong and the vesicle between the occlusor muscles large as in *P. litoralis*.

The specimen from Torres Straits (B.M. 90.3.24.38) recorded by Kirkpatrick (1890*a*, p. 612) as *Mucronella magnifica* proves to be a colony of *P. vultur* var. *serrata*, and examination of part of Thornely's specimen from the Gulf of Manaar in the Cambridge Museum



TEXT-FIG. 14.—*Petralia vultur* var. *serrata*, Livingst. Oral (A, B) and frontal (C, D) avicularia, oblique and basal views.

confirms Livingstone's surmise that it could be identified with his variety. *Petraliella albirostris*, Canu and Bassler (1927*b*, p. 22), appears to be related, and resembles vars. *serrata* and *armata* in having numerous small frontal avicularia.

Marcus (1922, p. 441, *P. aviculifera*) had a form which appears to be very closely related to var. *serrata*. It resembles Livingstone's rather than my specimens in the orifice, which is longer than wide, with a narrow denticle. It has larger teeth on the small mandibles. Marcus identified it with *Mucronella aviculifera*, Hincks (1891, p. 297), but part of Hincks's specimen is in the British Museum (99.5.1.853), and is clearly distinct. The three slender columns by the orifice, one median proximal and two lateral distal, are exactly as figured by Hincks, and sometimes, at least, bear the minute avicularia shown by him. There is no trace of the distal spines, nor of the stout umbo with a lateral avicularium shown by Marcus. The median denticle of Hincks's specimen is very narrow, but the large frontal avicularia are blunt, not pointed as in Hincks's figure. They are raised, and may overhang the orifice. The zooecia are smaller and the orifice smaller and rounder than in Marcus's species.

Kirkpatrick's specimens of *P. thenardii* only differ from *P. aviculifera* (Hincks) in the branched proximal column. They have similar large frontal avicularia overhanging the orifice. They may, as suggested by Thornely (1905, p. 124), be the same species, as may also be *P. laccadivensis* (Robertson, 1921, p. 57).

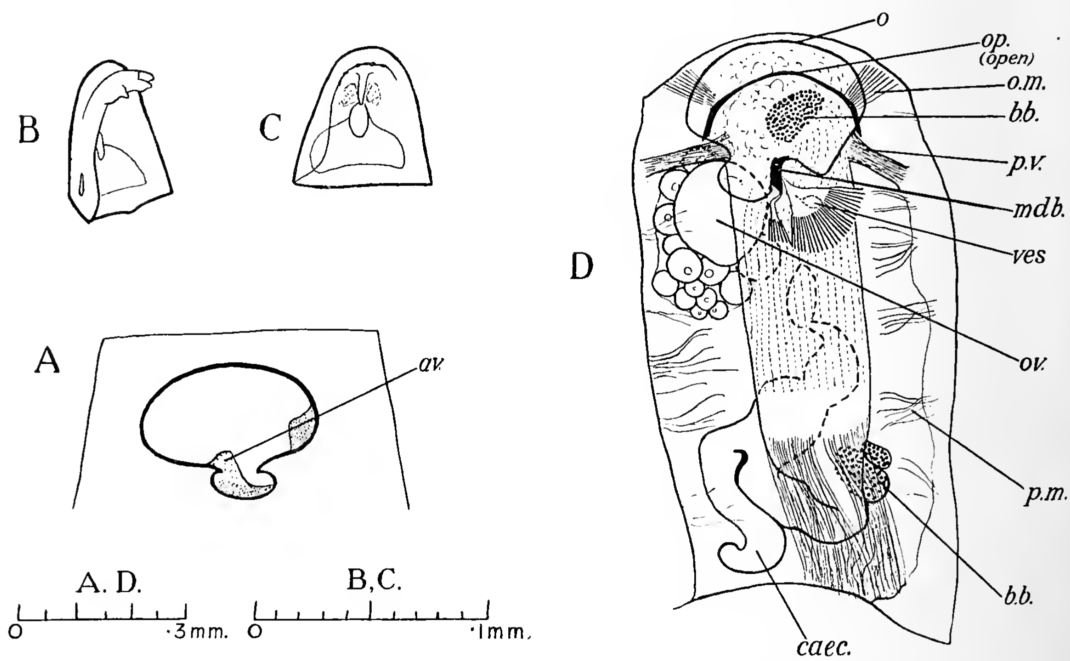
Petralia litoralis, Livingstone, sp. n. (Plate I, fig. A ; Text-fig. 15.)

Petralia litoralis, Livingstone MS.
? *Petralia elongata*, Canu and Bassler, 1929, p. 259, pl. xxiv, fig. 8.

OCCURRENCE.—Low Isles (shore), off N. Anchorage.

TYPE.—Specimen from shore (B.M. 32.4.20.61).

DESCRIPTION.—The colony is unilamellar, and brown coloured even when preserved. In life the specimens were a chocolate-brown colour. The shore specimens are loosely encrusting, and were found under dead coral; the dredged one is unattached.



TEXT-FIG. 15.—*Petralia litoralis*, Livingstone, sp. n. A, Orifice seen from within. Primary orifice thickly outlined, peristome and avicularium stippled. B, C, Oral mandible, oblique and basal views. D, Decalcified zooecium. *av.*, Avicularium. *b.b.*, Brown body. *caec.*, Caecum. *mdb.*, Mandible. *o.*, Orifice. *o.m.*, Occlusor muscle. *op.*, Operculum. *ov.*, Ovary. *p.m.*, Parietal muscle. *p.v.*, Parietovaginal muscle. *ves.*, Vesicle.

The orifice is more or less semicircular, with a sinus to one side. The sinus is limited by a pair of hinge teeth, of which one is longer than the other (Text-fig. 15, A). The smaller hinge tooth is almost in the median line and is hidden in frontal view by the oral avicularium. The larger hinge tooth and part of the sinus are visible in frontal view. The avicularium is placed transversely and has a hooked beak. The peristome is nodular and irregular, but forms a small umbo behind the avicularium. The ovicell has the usual finely punctured ectooecium. The ectooecium, which is uncalcified in young zooecia, becomes very unevenly calcified, sometimes forming radial calcareous bands (Plate I, fig. A).

On some zooecia there is a small, transverse, ligulate avicularium on the frontal wall (Plate I. fig. A). It is placed laterally and, though raised, is inconspicuous. The calcareous beak is hooked with a finely beaded edge. The mandible of the oral avicularium is bluntly triangular (Text-fig. 15. B, C). It has a toothed flange somewhat resembling that in *P. vultur* var. *serrata*, but more prominent distally. There are bosses for the attachment of the occlusor muscles, with a narrow longitudinal sclerite between them. As in the oral mandible of *P. vultur* var. *serrata*, described above, one of the lateral edges appears to be turned in. In the natural position of the mandible this edge is directed frontally. There is a rather large vesicle between the occlusor muscles (Text-fig. 15, D). Except for its greater length, the mandible of the frontal avicularium is like that of the oral avicularium.

The polypide (Text-fig. 15, D), like that of other Petraliidae, has a large number of long tentacles. The caecum is long and slender. The occlusor muscles of the operculum are attached to the distal wall. The parieto-vaginal muscles take the form of a single broad band on each side. The parietal and retractor muscles are very fine and numerous. There is a single ovary at one side of the zooecium. It has a large number of ova, of which one is usually much larger than the rest.

Remarks.—Since Mr. Livingstone sent me his manuscript, Canu and Bassler's work on the Bryozoa of the Philippine Islands (1929) has been published, describing a large number of species of Petraliidae. Most of their new species differ from *P. litoralis* in possessing a lyrula. Of those that do not, *P. crassocirca* has a symmetrical orifice with a straight proximal border, an unraised peristome, and a rather conspicuous acute avicularium on each side of the orifice. This leaves *P. gigantea*, *P. grandicella* and *P. elongata*. The first two are larger in all their measurements, differ in the number and size of the dorsal radicular pores, and have larger and less numerous frontal pores. In its dimensions and in the size and number of the frontal pores *P. litoralis* resembles *P. elongata*. In *P. litoralis* there may be more than one dorsal pore, there are no avicularia on the " shield," and there may be a frontal avicularium. There are, however, large tracts in which no zooecium has a frontal avicularium. *P. litoralis* is thus very near to *P. elongata*, and, when the characters of *P. elongata* are more fully known, may be found to be synonymous with it.

Rhynchozoon longirostre (Hincks).

Rhynchopora longirostris, Hincks, 1881*c*, p. 125, pl. iv, figs. 7, 8 ; Waters, 1889, p. 19 ; Macgillivray, 1890*b*, pp. 356, pl. cxcvi, figs. 11–14 ; Kirkpatrick, 1890*a*, p. 612 ; Maplestone, 1909, p. 268.
Escharoides verruculata, Busk, 1884, p. 150.
Rhynchozoon longirostris, Hastings, 1930*a*, p. 729, pl. xiv, figs. 89, 90.

Occurrence.—St. II.

Distribution.—Australia, Heard Island.

There is one small colony of this species. The mandible of the large frontal avicularium sometimes extends beyond the beak and is somewhat expanded distally, but the beak is of the usual form. In all other respects the specimen is typical.

Retepora graeffei (Kirchenpauer).

Retihornera graeffei, Kirchenpauer, 1869, p. xxx.
Retepora producta, Busk, 1884, p. 108, pl. xxv, fig. 7 ; Waters, 1913, p. 525, pl. lxxii, figs. 9, 10 (synonymy); Marcus, 1922, p. 433.
Retepora graeffei, Marcus, 1921*a*, p. 15 ; Livingstone, 1927, p. 59.

Occurrence.—Box sunk in Anchorage, collected 29.v.29; N.W. Low Is.; off N. Anchorage; St. XII, XIV, XXVI.

Distribution.—N. Australia, Oceania, Indian Ocean.

This is *R. producta*, Busk. Following Marcus and Livingstone, Kirchenpauer's name is used, although the identity of Kirchenpauer's species with Busk's cannot be regarded as finally proved till the type has been examined. The specimen of *R. producta* in the British Museum, regarded by Waters as possibly the type of *R. graeffei*, is probably not the holotype. It is one of the specimens offered for sale (Mus. Godeffroy Cat. IV, p. 119, no. 3919), and was bought by the British Museum. On the title-page of Cat. III it is stated that the specimens for sale are duplicates and, as only two of the six species of *Retihornera* described by Kirchenpauer are offered for sale (Cat. IV, p. 119), it may be assumed that a series of specimens was retained in Hamburg. If so, these must be regarded as the holotypes.

Retepora monilifera var. *munita*, Hincks.

Retepora monilifera var. *munita*, Hincks, 1878, p. 361, pl. xix, fig. 5; Marcus, 1921*a*, p. 16, pl. i, figs. 6, 7; Livingstone, 1927, p. 58; 1928, p. 117.

Retepora monilifera form *munita*, MacGillivray, 1884*a*, p. 108, pl. i, fig. 3; 1885*b*, p. 22, pl. xciv, fig. 4, pl. xcvi, figs. 4–8; 1890*c*, p. 6; Kirkpatrick, 1890*a*, p. 612; Marcus, 1921*b*, p. 14.

Occurrence.—St. II.

Distribution.—Australia, Aru Is.

In these specimens the trabeculae are rather narrow and the fenestrae vary in width, some being a little wider, others narrower than the trabeculae. The vibices are conspicuous and enclose rather large areas. The opercula are longer than broad. They resemble those of *R. monilifera* in being fairly strongly chitinized, but are not wider proximally. The peristome is thick and raised on the older zooecia, forming a rather deep, wide sinus which frequently has an avicularium at one corner. These avicularia may have a very broad, short mandible, considerably less than a semicircle, with strong sclerites and a beaded edge, or a longer, less chitinized blunt mandible, as figured by Macgillivray (1884*a*, pl. i, fig. 4, small mandible on right). Both types of avicularia also occur on the frontal surface of the zooecia and on the edges of the fenestrae. The large suprafenestral avicularium has a strongly curved pointed mandible. The central part of the blade is thicker but without definite sclerites. The lateral thinner parts of the blade widen to form a blunt point on each side, thus differing from Macgillivray's figure, in which the mandible tapers uniformly. When the mandible is closed, the two points of the calcareous beak stand up between these lateral points and the terminal point. Similar avicularia occasionally replace the small ones on the frontal surface of the zooecia. They also occur on the basal surface, but here they are very flat. Those on the frontal surface have a prominent avicularian chamber. The ovicells are considerably taller than broad. The stigma is correspondingly elongated, sometimes the median arm, sometimes the two proximal ones being the longest. The angle between the proximal arms is acute. In Hincks's specimen of *munita* from Port Phillip Heads (B.M. 99.5.1.1257) the suprafenestral avicularium is larger, and the plane of its opesia is nearly at right angles to the plane of the mandible when closed.

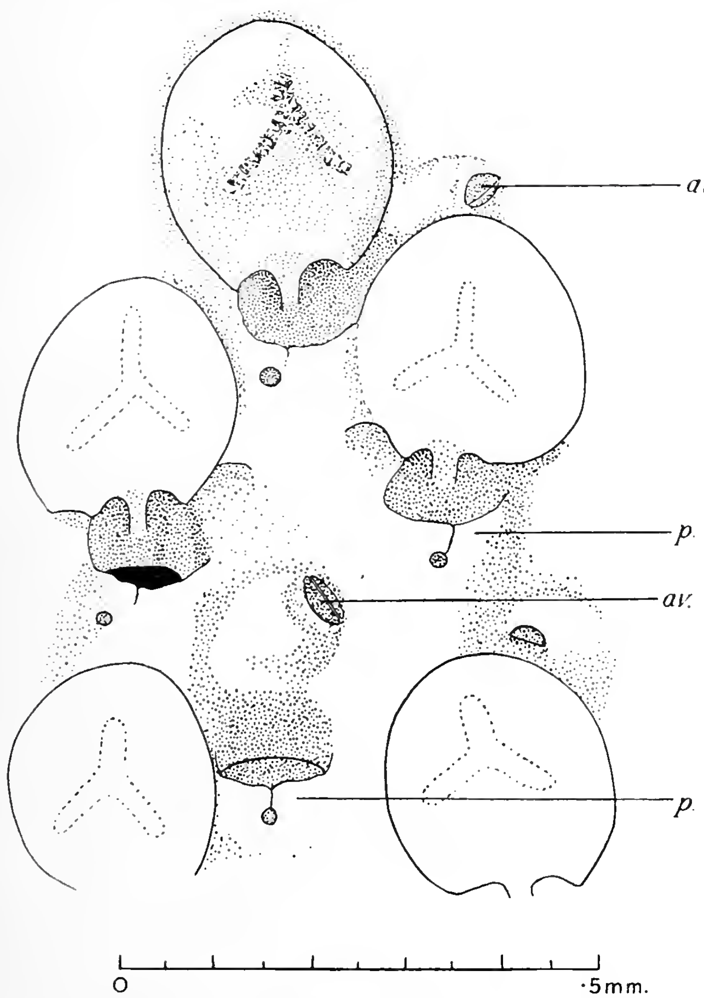
Retepora monilifera var. *benemunita* (Busk), var. nov. (Plate I, fig. E; Text-figs. 16, 17.)

Retepora benemunita, Busk MS.

Occurrence.—Australia (Busk Coll., B.M. 99.7.1.70, 71, 2930, 2952–2956, 4854; 82.7.29.82): Low Is., 12 fath.: off N. Anchorage; St. II, XII.

Type.—B.M. 99.7.1.70.

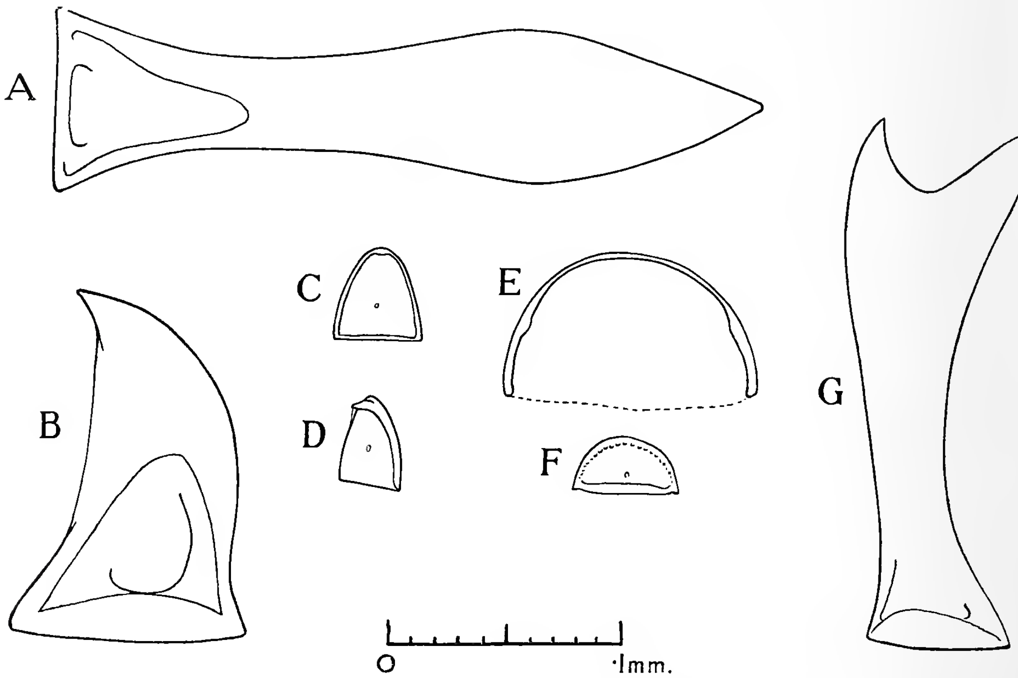
The type-colony (Plate I, fig. E) consists of irregular tubular meshes with the zooecia on their inner surface. In the Barrier Reef specimens the tubes may have a greater



Text-fig. 16.—*Retepora monilifera* var. *benemunita* (Busk) var. n. Part of Barrier Reef specimen treated with Eau de Javelle and seen by reflected light. *av.*, Avicularium. *p.*, Peristome.

diameter, and occasionally the zooecia are on the outer surface. The fenestrae are regular, and usually a little narrower than the trabeculae. The dorsal surface has distinct vibices outlining rather large areas. The zooecia (Text-fig. 16) are very regularly arranged, and are rather long and narrow. They are thin-walled, and the peristome is thin and rather prominent. The two sides are united, making it very even in height, and leaving a pore. There may be a fine spine on each side of the orifice. The operculum is almost semicircular (Text-fig. 17, E). The peristome bears a triangular avicularium, whose mandible has a slightly down-turned point, and there may be a semicircular avicularium on the frontal wall (Text-fig. 17, C, D, F). In the type a few larger and more prominent avicularia with a

pointed, strongly curved mandible (Text-fig. 17, B) are found on both the frontal and the basal surface. These have not been found in the Barrier Reef specimens. There may be a raised avicularium directed into the proximal angle of the fenestra as in *R. tubulata*. Its mandible is bifid (Text-fig. 17G), and somewhat variable in shape; as a rule, however, its ends are shorter and less sharply pointed than those of *R. tubulata*. A few of these fenestral avicularia are present in the type, and they are common in other specimens. On the basal surface there are a few large avicularia with a long narrow mandible (Text-fig. 17, A), those of the Barrier Reef specimens being longer and narrower than those of the type. There are also small round ones bordering the fenestrae. The ovicells are prominent, and may be more or less spherical or a little longer than broad (Text-fig. 16). The longitudinal arm of the stigma is usually the shortest. The oral glands are rather conspicuous.



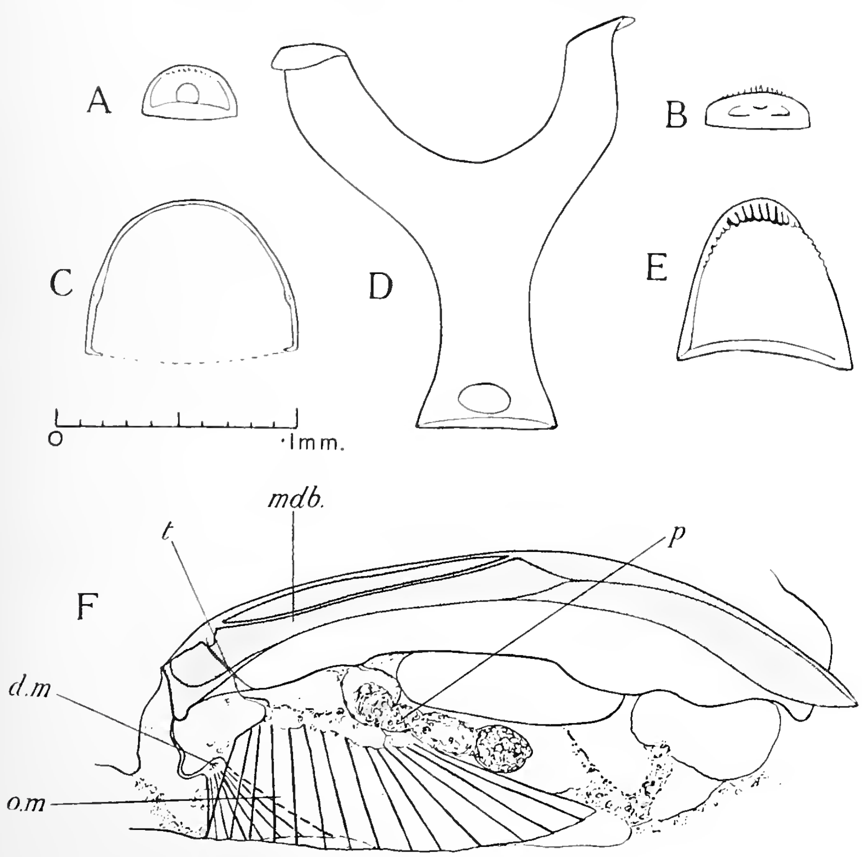
TEXT-FIG. 17.—*Retepora monilifera* var. *benemunita* (Busk), var. n. Chitinous parts of type. A, Mandible of large basal avicularium. B, Mandible of large triangular avicularium, oblique view. C, D, Oral mandible, frontal and oblique views. E, Operculum. F, Mandible of small frontal avicularium. G, Mandible of fenestral avicularium, oblique view.

The specimen from St. II differs in some ways. It agrees in the shape of the operculum and oral avicularium and in the presence of the bifid, proximal, fenestral avicularium. The peristome is thickened and somewhat pointed above the oral avicularium. The ovicell is slightly umbonate. There are a few large avicularia placed above the fenestra as in var. *munita*, but they have a bifid mandible, and the calcareous beak has three sharp points between which the tips of the mandible lie when it is closed. The mandible is long and slender, with long sharp points. As in var. *munita*, it is occasionally replaced by a highly chitinized semicircular mandible. The proximal fenestral avicularia are rather small and not very numerous in this specimen.

One specimen from St. XII has the characteristic zooecia, opercula and oral avicularium, but has no large fenestral avicularia. It has no ovicells. A dead specimen from the same station has the characteristic basal and fenestral avicularia.

Remarks.—This form is clearly allied to *R. monilifera*, but differs from the described varieties in the pointed oral avicularium, and, from most of them, in having an operculum that is wider than high (see Macgillivray, 1885*b*, pl. xciv, figs. 1, 2, 4, 5, though Marcus, 1921*a*, p. 17, regards the wide operculum as characteristic of the group). These two peculiarities, associated with the presence of a bifid fenestral avicularium and the general characteristics of the zooecia and ovicells, make necessary the introduction of a new name, which for the sake of uniformity with the present nomenclature in the *R. monilifera*-group may be regarded as designating a variety of *R. monilifera*. As the form was clearly recognized by Busk, under the manuscript name of *R. benemunita*, I have used that name and chosen one of Busk's two colonies as the holotype. In the Barrier Reef specimens collected in September, October and November, reproduction appears to be at its height, for the body cavities contain abundant eggs and sperm. In the specimens collected in February very few reproductive bodies have been seen. These colonies, in which the almost spherical oral glands are large and conspicuous, may have been formed from larvae produced the same summer.

Retepora tubulata, Busk. (Text-fig. 18.)



Text-fig. 18.—*Retepora tubulata*, Busk. A–E, Chitinous parts of type-specimen. F, Decalcified fenestral avicularium from Barrier Reef specimen, side view, mandible stippled. A, B, Mandible of semicircular avicularium, frontal and distal views. C, Operculum. D, Mandible of fenestral avicularium. E, Mandible of triangular avicularium. *d.m.*, Divaricator muscle. *mdb.*, Mandible. *o.m.*, Occlusor muscle. *p.*, Rudimentary polypide ? *t.*, Tendon of occlusor muscle.

Retepora tubulata, Busk, 1884, p. 121, pl. xxviii, fig. 2, text-fig. 32; MacGillivray, 1887*a*, p. 184; Thornely, 1905, p. 125; 1907, p. 193.
? *Retepora tubulata* var. Waters, 1913, p. 526.

Occurrence.—St. II.

Distribution.—Cape York, Malaya, Ceylon, Zanzibar ?

Busk's figures do not show his usual accuracy, so the chitinous parts have been drawn again from his preparation (Text-fig. 18, A–E). It will be seen that the sides of the operculum are not curved inwards proximally, that the teeth on the triangular avicularia are large and closely set, and that the semicircular avicularia are also toothed. Except for variation in size of the triangular avicularia, the chitinous parts of the Barrier Reef specimen agree with them, but there are in addition a few avicularia on the margins of the fenestrae with very thin, semi-elliptic mandibles. The Barrier Reef colony has not begun to form the tubes characteristic of the zoarium of *R. tubulata*. It is young, but its growth has extended beyond the point where the tubular structure begins in the type. There is a fine spine on each side of the orifice. The "boat-shaped" avicularium (Text-fig. 18, F) is present in most of the fenestrae. The larger frontal avicularia are raised on short stout columns resembling the much taller and more numerous ones of *R. columnifera* (Busk, 1884, pl. xxvi, fig. 5*c*), which is very closely allied if not synonymous. It is difficult to know what Busk meant by the "numerous solid or tubular, calcareous, columnar processes, springing from the dorsal surface" for attachment in *R. columnifera*. Only two are visible in the type, and they do not differ from the secondary attachments of other *Reteporidae* (see Buchner, 1924, p. 160, text-fig. A).

Eggs and sperm can be seen in the body-cavities, and in some zooecia a pair of oral glands has been observed.

Holoporella mamillata (Busk). (Text-fig. 19, A–D.)

Cellepora mamillata, Busk, 1854, p. 87, pl. cxx, figs. 3–5; Hincks, 1881*a*, p. 267; Waters, 1887, p. 197; Philipps, 1899, p. 440; Thornely, 1912, p. 155; Marcus, 1921*b*, p. 18.

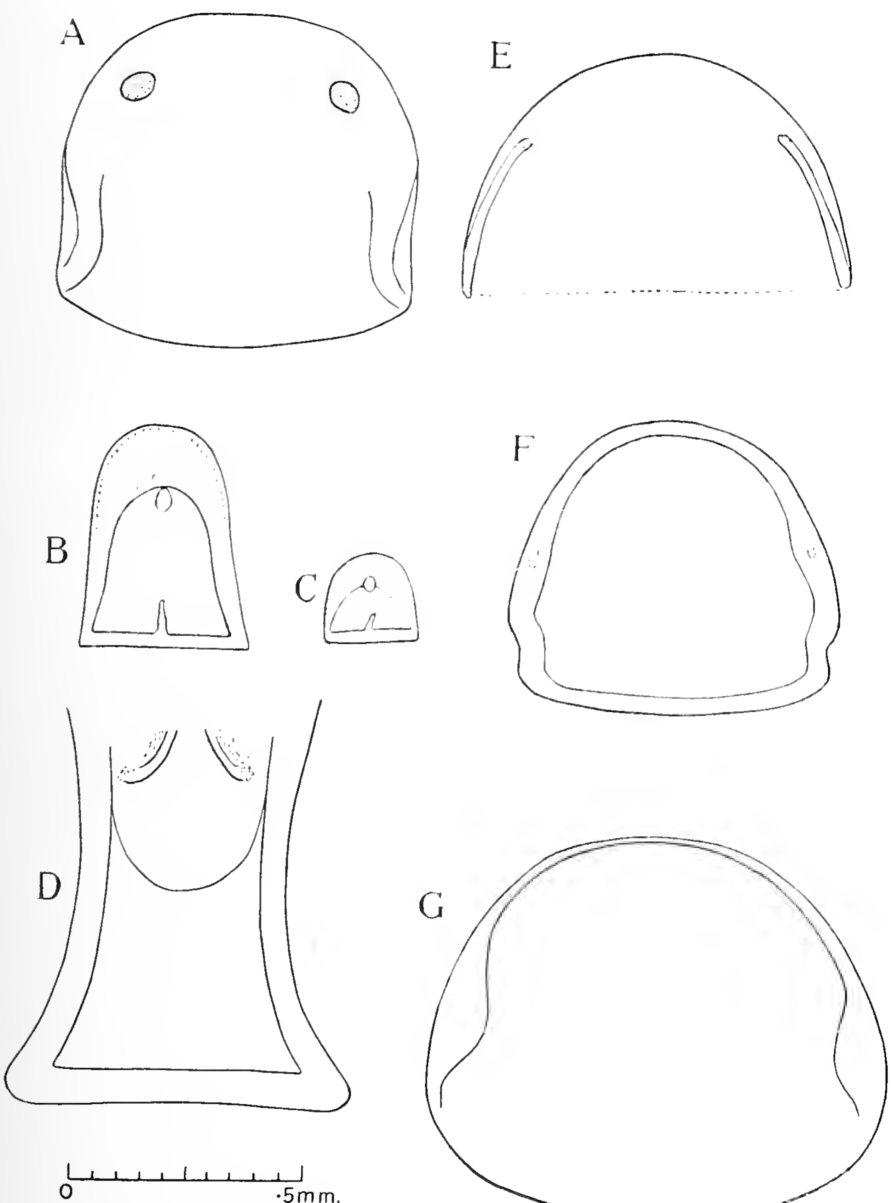
Occurrence.—Low Is., 12 fath.; St. XIII, XXII.

Distribution.—Australia, Malaya, Loyalty Islands, Indian Ocean, Patagonia.

These specimens agree very exactly with the type of *H. mamillata*. Busk (1884, p. 199) did not find the large "retentive" avicularia in Australian specimens, but a few are present in those from the Barrier Reef and are exactly like those of the type, the base of one of which is shown in Text-fig. 19, D. The spatulate and semicircular avicularia are like those of the type (Text-fig. 19, B, C), and show similar variation in the size of the lucida and the length of the columella. They have a delicate terminal flange, with a finely toothed edge. The spatulate mandibles vary a good deal in size. In the Barrier Reef specimens the opercula are a little larger and the lateral sclerite reaches the muscle attachment, which it can rarely be seen to do in the type (Text-fig. 19, A). This, the only distinction noted, can hardly be regarded as a specific difference. The muscle attachments in the type and the present specimens are nearer the distal end of the operculum than in the allied species.

The oral glands of the specimen from St. XXI resemble those described by Waters in species of *Holoporella* (1909, p. 165; 1913, p. 522, pl. lxxiii, fig. 11), being long and thin-walled, with homogeneous contents. Similar glands can be seen in Busk's preparation of *H. hastigera*.

A specimen from the Barrier Reef sent by Mr. Livingstone as *H. pigmentaria*, Waters (1909, p. 163), is the species here regarded as *H. mamillata*. The true *H. pigmentaria* appears to be more nearly allied to *H. mamillata* var. *atlantica*, Busk (1884, p. 199), which



Text-fig. 19.—*Holoporella.* Chitinous parts of: A–D, *H. mamillata* (Busk), type-specimen. E, *H. mamillata* var. *atlantica* (Busk), Challenger Coll., St. 148. F, *H. albirostris* (Busk), Challenger Coll., St. 151. G, *H. albirostris* (Hincks), Bass Strait.

differs from typical *H. mamillata* in its operculum (Text-fig. 19, E). *H. pigmentaria*, which is described as resembling *H. mamillata* except for its operculum, has a similar operculum to that of var. *atlantica*, and might be expected to be synonymous with it. No columella is, however, shown in Waters's figures of the mandibles. *H. mamillata* may sometimes

have been confused with other pigmented Australian species, such as *H. albirostris*—a name which appears to have been given to two Australian species, both of which may be distinct from *H. albirostris* (Smitt, 1873, p. 70) from the Gulf of Mexico.

A specimen from the Tortugas (B.M. 31.12.19.35) appears to be Smitt's species. It differs from Smitt's description in its colourless opercula, but the degree of pigmentation in the dark species of *Holoporella* is variable, and the range of size of the orifice given by Smitt shows that he did not distinguish the large *H. magnifica*, Osburn (1914, p. 216), in which the opercula are black. The opercula of this Tortugas specimen of *H. albirostris* agree in size and shape with that figured by Canu and Bassler (1928*b*, p. 142, text-fig. 31A, B), but I have not seen the type shown in text-fig. 31C. The spatulate avicularia have a columella. *H. albirostris* (Busk, 1884, p. 193) has opercula (Text-fig. 19, F) and oral avicularia of a different shape. Canu and Bassler suggested that the difference in the opercula might be explained by distortion in Busk's preparation, but examination of the type slide shows that their shape is so regular and constant that one cannot suppose them to be distorted. The Mexican *H. albirostris* (Smitt) is therefore distinct from *H. albirostris* (Busk), though a specimen from Sydney (B.M. 62.2.4.35), believed to be the one mentioned by Smitt (1873, p. 70), agrees with *H. albirostris*, Busk. *H. albirostris* (Hincks, 1881*a*, p. 267), from Bass Strait, is represented in the British Museum (82.7.29.3 ; 99.7.1.3213, 3214, 3287) by specimens sent by Hincks to Busk, who (1881*b*, p. 362, explanation pl. xxvi ; 1884, p. 193, synonymy) recognized their distinctness from his own species. *H. albirostris* (Hincks) differs from both Smitt's and Busk's species of that name in its opercula (Text-fig. 19G). They are larger and have no lateral sinuation. The lateral sclerite is thickened to form a rather knob-like flange, and the occlusor muscle is attached just distally to this thickening. A specimen from New Zealand (B.M. 75.1.5.51) also belongs to this species.

Busk (1881*a*, p. 344) distinguished *H. hastigera* from *H. albirostris* chiefly by the absence of spines. Examination of the types shows that their chitinous parts agree exactly, and that, although no spines can be seen in *H. hastigera*, some have been formed, for their basal chitinous joints remain. *H. hastigera* and *H. albirostris* (Busk) are thus probably synonymous as suggested by Waters (1885, p. 305), and should be called *H. hastigera*. The type-colonies of both species have ridges of the kind which, in its extreme development, gives *H. lirata* (Macgillivray, 1888, p. 250) its characteristic appearance.

Marcus (1921*a*, p. 24) has remarked on the improbability of *H. mamillata* being unknown to Macgillivray, and suggests that *H. verrucosa* (Macgillivray, 1888, p. 245) may be a synonym. It differs, however, in the shape of the operculum. A specimen in the Cambridge Museum determined by Macgillivray as *C. albirostris*, Smitt, appears to be *H. albirostris*, Busk (*H. hastigera*).

Holoporella intermedia (Macgillivray). (Text-fig. 20.)

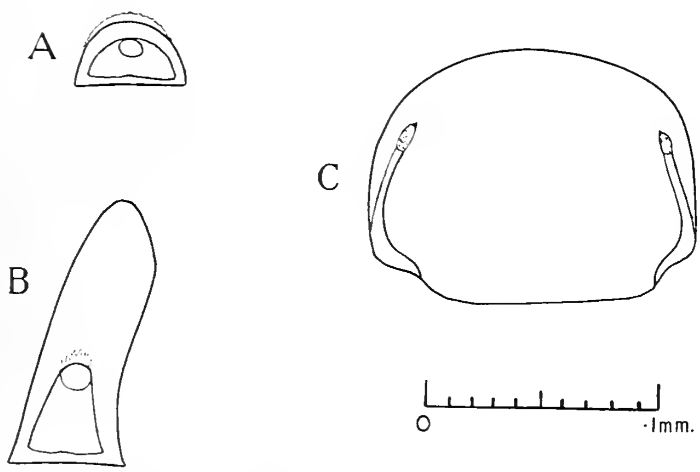
Cellepora intermedia, Macgillivray, 1869, p. 137 ; 1888, p. 247, pl. 166, fig. 3.

OCCURRENCE.—Off N. Anchorage.

DISTRIBUTION.—Queenscliff.

This unattached, irregularly mamillated, laminate colony, measuring $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., agrees with Macgillivray's description, except that the spatulate avicularia are not spoon-shaped, or specially large (Text-fig. 20, B).

The orifice is semicircular, with a rather conspicuous condyle at the proximal end of each side. The operculum (Text-fig. 20, C) is broader than long, and concave and a little thickened opposite the condyles. Many zooecia have no avicularium ; others have a small



TEXT-FIG. 20.—*Holoporella intermedia* (Macg.). A, Semicircular mandible, slightly distal view. B, Spatulate mandible, oblique view. C, Operculum.

one (Text-fig. 20, A) on a low eminence proximal to the orifice. In some parts of a colony in the Cambridge Museum these low eminences are developed into tall columnar processes. The zooecia of this colony also differ in having a slightly larger orifice.

Holoporella fusca (Busk).

Cellepora fusca, Busk, 1854, p. 88, pl. cxix, fig. 2 ; cxx, fig. 6 ; 1881*b*, pl. xxvi, fig. 11 ; 1884, pl. xxxv, fig. 14 ; Maplestone, 1882, p. 51 ; Macgillivray, 1888, p. 249, pl. clxvii, fig. 2 ; pl. clxviii, fig. 16 ; Kirkpatrick, 1890, p. 612.

Holoporella fusca, Waters, 1909, p. 161 ; Marcus, 1921*a*, p. 24, pl. i, figs. 11, 11*a* ; Livingstone, 1927, p. 65.

OCCURRENCE.—St. XXII.

DISTRIBUTION.—Australia.

These specimens correspond exactly to Busk's description, figures and type-specimens. Macgillivray (1888, p. 249) had specimens which differed in having the spatulate avicularia directed upwards on the sides of conical rostra. In the type and in the Barrier Reef specimens the mandible is parallel to the surface of the colony.

Holoporella tridenticulata (Busk).

Cellepora tridenticulata, Busk, 1881*a*, p. 347 ; 1881*b*, pl. xxvi, fig. 9 ; 1884, p. 198, pls. xxix, fig. 3 ; xxxv, fig. 17 ; Macgillivray, 1890*c*, p. 6.

Holoporella tridenticulata, Thornely, 1912, p. 155 ; 1916, p. 164 ; Robertson, 1921, p. 61 ; Livingstone, 1927, p. 65 ; Canu and Bassler, 1930, p. 39, pl. vii, figs. 2 and 3 (references).

OCCURRENCE.—St. XII, XIII.

DISTRIBUTION.—Australia, Indian Ocean, Galapagos Islands.

This specimen agrees exactly with the type-specimen. The curious tubes mentioned by Busk, Thornely (1912), and Canu and Bassler, contain Spionid Polychaets, probably belonging to the genus *Polydora*. A similar Polychaet can be seen in one of the type-slides (B.M. 82.7.29.20).

Catenaria lafontii (Audouin).

Eucratea lafontii, Audouin, 1826, p. 242 ; Savigny, pl. xiii, figs. 2^{1}–^{7}.
Catenaria lafontii, Hastings, 1927, p. 346 (references) ; 1930*a*, p. 732.
Savignyella lafontii, Osburn, 1927, p. 126.

Occurrence.—St. XVI.
Distribution.—Indian Ocean, Mediterranean, Atlantic, E. Pacific.

Vittaticella elegans (Busk).

Catenicella elegans, Busk, 1852*a*, p. 361, pl. i, fig. 2 ; Kirkpatrick, 1890*b*, p. 16 ; Thornely, 1905, p. 109 ; Marcus, 1922, p. 431, pl. xxiv, fig. 7 (references).
Vittaticella elegans, Okada, 1921, p. 27 ; Livingstone, 1927, p. 57 ; 1929, p. 99.

Occurrence.—St. II, VIII, XVI.

Distribution.—Australia, Tasmania (Cambridge Museum), New Zealand, Malaya, Japan, Indian Ocean, Tristan da Cunha.

The Barrier Reef specimens attributed to this species differ from the type-specimens in their slender zooecia, in the small size of their scapular (avicularian) chamber and in the arrangement of the vittae at the bifurcation. In typical *V. elegans* the vitta (" pedal-chamber ") on the adzooecial side of the daughter-zooecium is short, and there is a boundary chamber (Levinsen, 1909, p. 256). In the Barrier Reef specimens the vitta is long, and has an expanded tip occupying the position of the boundary chamber of the type. This arrangement is well figured by Marcus (1922, pl. xxiv, fig. 7), whose specimens from the Aru Islands resembled those from the Barrier Reef. Like some of those from the Barrier Reef, Marcus's specimen had a large transverse avicularium on the adzooecial side of the daughter zooecium at a bifurcation. Other specimens whose zooecia resemble those of the Barrier Reef specimens rather than the type of *V. elegans*, and which possess this avicularium, are those of Waters (1913, p. 484) from Zanzibar, that from the Arafura Sea mentioned by Waters (B.M. 82.2.23.409), and Busk's specimens from S. Africa, mentioned (1852*a*, p. 361) as differing from *V. elegans*, and later (1852*b*, p. 10) identified with it. The existence of specimens only differing from these in the absence of the large avicularia is not surprising. Such are the " Challenger " specimen from St. 188 (Torres Straits), Kirkpatrick's from the same locality (1890*a*, p. 611), Thornely's from Ceylon (1905, p. 109), part of which is in the Cambridge Museum, and some from the Barrier Reef. Others, such as the " Challenger " specimens, except those from St. 188, are more definitely intermediate, and have led me to include both forms in *V. elegans*. They have the slender zooecia and small scapular chamber of the Barrier Reef specimens with the boundary chamber and short vitta of the type.

Macgillivray's description of *V. gracilenta* (1885*a*, p. 106, pl. i, fig. 3), suggests the Barrier Reef form, except that he does not mention a beaded border to the ovicell, or the presence of large avicularia, but his figure, which shows the long vitta on the adzooecial side of the daughter zooecium, represents a larger form. The long stout zooecia, with very wide vittae at the proximal end of his figured specimen, resemble the proximal zooecia of colonies of *V. gibbosa ;* the whole figure might indeed represent a basal portion of a colony of that species. This suggestion is supported by the fact that in the first collection sent to the British Museum by Bracebridge Wilson this species is represented by specimens (B.M. 88.11.14.22, 28) which have a slight indication of the distal ridge of *V. gibbosa,*

and in other respects agree exactly with the type-specimen of that species. Kirkpatrick's specimen of *V. gibbosa* from Torres Straits (B.M. 90.7.23.35) shows that there may be considerable variation in the degree of development of this ridge and of its spines. The supposed specimens of *V. gracilenta* in the second Bracebridge Wilson Collection (B.M. 97.5.1.46–50), received ten years later, are much smaller and more delicate than the species figured by Macgillivray, and have a boundary chamber and short vitta on the daughter zooecium as in typical *V. elegans*.

Another species resembling the Barrier Reef specimens in the long vitta of the daughter zooecium is *V. buskii* (Thomson, 1858, p. 139), of which I have examined part of the type material. It is, however, a larger, stouter species with large, sharply pointed scapular chambers on all but the more basal zooecia. Those of the distal zooecia are specially sharp and frequently are not avicularian. The basal zooecia show most clearly the cylindrical form and short joints described by Thomson. Those more distally placed taper proximally and have slightly longer joints. Marcus (1921*a*, p. 10) suggests that *V. buskii* may be a synonym of *V. gibbosa*, and he may be right. They agree in the size and general shape of the zooecia. *V. gibbosa* shows some tendency to form pointed scapular chambers, but in the material available to me they are shorter and always avicularian. *V. buskii* does not, in my experience, show any tendency to form a distal ridge with spines, and the "bottle-brush" form of its colony is, if constant, another minor distinction between it and *V. gibbosa*, in which such a form has not been found. A large and typical colony of *V. buskii*, recently obtained from the Hong-Kong Manilla cable (B.M. 30.1.9.6), shows this form very well (Plate I, fig. B), consisting of a number of very regular "bottle-brush" shoots branching from a strong stalk.

V. fusca (Macgillivray, 1884*b*, p. 33), which, according to Waters (1913, p. 483, footnote), is a synonym of *V. umbonata*, Busk (1852*b*, p. 11), resembles *V. buskii*, *V. gracilenta* and *V. gibbosa* in its long cylindrical basal zooecia with broad vittae, and in the arrangement of the vittae at a bifurcation. Like them it is larger and stouter than *V. elegans*. All these forms agree in the structure of their ovicells. In Thomson's figure of *V. buskii* the marginal beading appears to be continued across the lip, but this is not so in his specimen. There may be considerable variation, even within the colony, in the size and shape of the frontal uncalcified area, which may be large or small, quadrangular or oval. The marginal "beading" may be only a single row of pores, or there may be a few others scattered on the frontal surface. In this, too, there is individual variation. As both Marcus (1921*a*, p. 9) and Waters (1887, p. 87) expressed some uncertainty as to the meaning of Busk's statement that the "ooecial cell" is geminate, it may be worth remarking that Busk was not referring to the ovicell, but to the fertile zooecium, meaning that the ovicell-bearing zooecium is not separated by a joint from the one distal to it.

APPENDIX.

On a Hydroid Associated with the Polyzoa.

Zanclea protecta, Hastings.

Zanclea protecta, Hastings, 1930*b*, p. 552, text-figs. 1–6.

Occurrence.—Low Is., 12 fath., and N.E. Low Is. on *Schizomavella australis*; off N. Anchorage on *Petralia litoralis*; St. II on *Retepora tubulata*; XIV on *Retepora graeffei*; XXI on *Holoporella mamillata*; IX on *Holoporella tridenticulata.*

Distribution.—E. Pacific, Tortugas on *Holoporella* spp. (B.M. 31.12.19.34.35).

One would expect the Barrier Reef specimens to belong to the allied species from Torres Straits, *Coryne cylindrica,* Kirkpatrick (1890*a*, p. 605), rather than *Z. protecta* from the Pacific. The type-material of *C. cylindrica* has, besides nematocysts resembling those of *Zanclea protecta*, considerable numbers of large ones of a different type. Their capsule measures ·032 × ·016 mm. and the thread is stout, about three times as long as the capsule, and spirally barbed. No such nematocysts are to be found in either the type-specimens of *Zanclea protecta* or the Barrier Reef specimens, which agree with the type-specimens exactly. The colony on *Retepora tubulata* commonly has a small medusa-bud in the angle between the hydranth and the hydrorhiza, thus differing slightly from the others.

The " parenchymatous cords " described by Waters (1888, p. 21, pl. iii, figs. 10, 10*a*) in *Retepora columnifera* from Torres Straits prove on examination of his slide (B.M. 89.12.12.2) to be the hydrorhiza of a hydroid of this type, typical hydranths also being present. Both hydranths and hydrorhiza contain large nematocysts resembling those of *C. cylindrica* except for their slightly smaller size, ·021 to ·017 × ·01 mm. It is presumably to be identified with *C. cylindrica.* The relation of the hydroid to the *Retepora* resembles that of *Zanclea protecta* to its host. Harmer (1909, p. 721; 1915, p. 12) discovered such an association of a Hydroid and *Retepora* in specimens from Malaya.

Kirkpatrick described *C. cylindrica* as forming a slender network on the basal surface of the Polyzoan and connected with the " heads of the hydroid " which projected from the frontal surface. Waters (1910, p. 254; 1913, p. 505) described a similar arrangement of a hydroid associated with *H. pigmentaria,* and concluded that the *Holoporella* had grown over and round established colonies of a free-living hydroid. No trace of a basal network has been found on any Polyzoa bearing *Zanclea protecta.*

Calcareous tubes similar to those described and figured (Hastings, 1930*b*) are frequently to be seen when examining Polyzoa, but in dry material the presence of the hydroid cannot be proved. The calcareous cups have not been seen in any species except *Smittina crosslandi*, but a small dry specimen of that species recently received from Ecuador (B.M. 31.12.8.2) bears two very much like those on the type.

REFERENCES.

Annandale, N. 1922. The Marine Element in the Fauna of the Ganges. Bijdr. Dierk. Amsterdam, XXII, pp. 143–154.

Audouin, V. 1826. Explication sommaire des Planches de Polypes de l'Égypte et de la Syrie. Déscription de l'Égypte, Hist. nat. I, 4, pp. 225–244.

Buchner, P. 1924. Studien über den Polymorphismus der Bryozoen. Zool. Jahrb. Jena, Syst. XLVIII, pp. 155–216, 3 pls., 21 text-figs.

Busk, G. 1852*a*. An Account of the Polyzoa and Sertularian Zoophytes. Appendix (59 pp., 1 pl.) to J. Macgillivray, Narrative of the Voyage of H.M.S. "Rattlesnake," I.

—— 1852*b*. Catalogue of Marine Polyzoa in the Collection of the British Museum, I. Cheilostomata (part). London.

—— 1854. Catalogue of Marine Polyzoa in the Collection of the British Museum, II. Cheilostomata (part).

—— 1860. Catalogue of the Polyzoa collected by J. Y. Johnson, Esq., at Madeira. . . . Quart. J. Micr. Sci., London, VIII, pp. 280–285, 2 pls.

—— 1879. Polyzoa, in Zoology of Kerguelen Island. Philos. Trans. London, CLXVIII, pp. 193–199, 1 pl.

—— 1881*a*. Descriptive Catalogue of the Species of *Cellepora* collected on the Challenger Expedition. J. Linn. Soc., London, XV, pp. 341–356.

—— 1881*b*. Supplementary Note respecting the Use to be made of the Chitinous Organs in the Cheilostomata in the Diagnosis of Species, and more particularly in the Genus *Cellepora*. J. Linn. Soc. London, XV, pp. 357–362, 2 pls.

—— 1884. The Cheilostomata. Rep. Zool. Chall. Exp. XXX.

—— 1886. Cyclostomata, Ctenostomata, Pedicellinea. Rep. Zool. Chall. Exp. L.

Calvet, L. 1900. Contributions à l'Histoire naturelle des Bryozoaires ectoproctes marins. Montpellier.

—— 1904. Bryozoen. Hamburger Magalhaenische Sammelreise, pp. 1–45, 3 pls.

Canu, F., and Bassler, R. S. 1917. A Synopsis of American Early Tertiary Cheilostome Bryozoa. Bull. U.S. Nat. Mus. XCVI, pp. 1–87, 6 pls.

—— 1920. North American Early Tertiary Bryozoa. Bull. U.S. Nat. Mus. CVI, pp. 1–897, 162 pls., 279 text-figs.

—— 1922. Studies on Cyclostomatous Bryozoa. Proc. U.S. Nat. Mus. LXI, 22, pp. 1–160, 28 pls., 40 text-figs.

—— 1923. North American Later Tertiary and Quaternary Bryozoa. Bull. U.S. Nat. Mus. CXXV, pp. 1–301, 47 pls., 38 text-figs.

—— 1927*a*. Classification of the Cheilostomatous Bryozoa. Proc. U.S. Nat. Mus. LXIX, 14, pp. 1–42, 1 pl.

—— 1927*b* and 1928*a*. Bryozoaires des Îles Hawaï. Bull. Soc. Sci. Seine-et-Oise, fasc. 7, suppl., pp. 1–66, 11 pls.

—— 1928*b*. Fossil and Recent Bryozoa of the Gulf of Mexico Region. Proc. U.S. Nat. Mus. LXXII, 14, pp. 1–199, 34 pls., 35 text-figs.

—— 1928*c*. Bryozoaires du Brésil. Bull. Soc. Sci. Seine-et-Oise, IX, 5, pp. 58–110, 9 pls.

—— 1929. Bryozoa of the Philippine Region. Bull. U.S. Nat. Mus. 100, 9, pp. 1–685, 94 pls., 224 text-figs.

—— 1930. The Bryozoan Fauna of the Galapagos Islands. Proc. U.S. Nat. Mus. LXXVI, 13, pp. 1–78, 14 pls., 13 text-figs.

Ehlers, E. 1890. Zur Kenntnis der Pedicellineen. Abh. Ges. Wiss. Göttingen, Phys. Kl. XXXVI, pp. 3–200, 5 pls., 7 text-figs.

Goddard, E. J. 1910. Contribution to our Knowledge of Australian Hirudinea, IV. With a Note on a Parasitic Entoproctous Polyzoon. Proc. Linn. Soc. N.S.W. XXXIV, pp. 721–732, 3 pls., 2 text-figs.

Goldstein, J. R. Y. 1880. Notes on Living Polyzoa. J. Micr. Soc. Vict. I, pp. 42–50.

Gray, J. E. 1848. List of the Specimens of British Animals in the Collection of the British Museum, I. Centroniae or Radiated Animals.

Haeckel, E. 1873. Ueber einige neue pelagische Infusorien. Jena. Z. Naturw. VII, pp. 561–568, 2 pls.

Harmer, S. F. 1900. A Revision of the Genus Steganoporella. Quart. J. Micr. Sci. XLIII, pp. 225–297, 2 pls.

Harmer, S. F. 1902. On the Morphology of the Cheilostomata. Quart. J. Micr. Sci. London, XLVI, pp. 263–350, 4 pls.

—— 1909. Presidential Address, Section D. Rep. Brit. Assoc. Adv. Sci. London, 1908, pp. 715–731.

—— 1915. Entoprocta, Ctenostomata, Cyclostomata. Rep. Siboga Exp. XXVIII*a*.

—— 1926. Cheilostomata Anasca. Rep. Siboga Exp. XXVIII*b*.

—— 1930. Polyzoa. Proc. Linn. Soc. London, CXLI, pp. 68–118, 1 pl., 11 text-figs.

Hassall, A. H. 1842. Remarks on the Genus *Lepralia* of Johnston with Descriptions of Six undescribed Species. Ann. Mag. Nat. Hist. IX, pp. 407–414.

Hastings, A. B. 1927. Report on the Polyzoa. Camb. Exp. Suez Canal. Trans. Zool. Soc. London, pt. 3, pp. 331–354, 7 text-figs.

—— 1930*a*. Cheilostomatous Polyzoa from the Vicinity of the Panama Canal. . . . Proc. Zool. Soc. London, 1929, part 4, pp. 697–740, 17 pls.

—— 1930*b*. On the Association of a Gymnoblastic Hydroid (*Zanclea protecta*, sp. n.) with various Cheilostomatous Polyzoa from the Tropical E. Pacific. Ann. Mag. Nat. Hist. 10, V, pp. 552–560, 6 text-figs.

Haswell, W. A. 1881. On Some Polyzoa from the Queensland Coast. Proc. Linn. Soc. N.S.W. V, pp. 33–44, 3 pls.

—— 1892. Observations on the *Chloraemidae*, with special reference to certain Australian forms. Proc. Linn. Soc. N.S.W. VI, pp. 329–356, 3 pls.

Hincks, T. 1877. On British Polyzoa, II. Ann. Mag. Nat. Hist. 4, XX, pp. 520–532.

—— 1878. Notes on the Genus *Retepora* with Descriptions of New Species. Ann. Mag. Nat. Hist. 5, I, pp. 353–365, 2 pls.

—— 1879. On the Classification of the British Polyzoa. Ann. Mag. Nat. Hist. 5, III, pp. 153–164.

—— 1880. A History of the British Marine Polyzoa. London.

—— 1881*a*. On a Collection of Polyzoa, from Bass's Straits. . . . Proc. Lit. Phil. Soc. Lpool. XXXV, pp. 249–270.

—— 1881*b*. Contributions towards a General History of the Marine Polyzoa, IV and V. Ann. Mag. Nat. Hist. 5, VII, pp. 147–161, 3 pls.

—— 1881*c*. *Op. cit.* VI and VII. Ann. Mag. Nat. Hist. 5, VIII, pp. 1–14, 122–136, 9 pls.

—— 1882. *Op. cit.* X. Ann. Mag. Nat. Hist. 5, X, pp. 160–170, 2 pls.

—— 1884*a*. *Op. cit.* XII, XIII. Ann. Mag. Nat. Hist. 5, XIII, pp. 356–369, 2 pls.

—— 1884*b*. *Op. cit.* XIII (cont.). Ann. Mag. Nat. Hist. 5, XIV, pp. 276–285, 2 pls.

—— 1887. On the Polyzoa and Hydroida of the Mergui Archipelago. . . . J. Linn. Soc. London, XXI, pp. 121–135, 1 pl.

—— 1891. Contributions towards a General History of the Marine Polyzoa, XV. Ann. Mag. Nat. Hist. 6, VII, pp. 285–298, 2 pls.

Johnston, G. 1847. A History of British Zoophytes, ed. 2. London.

Johnston, T. H., and Walker, M. J. 1917. A New Species of *Pedicellina* from Sydney Harbour. Proc. Roy. Soc. Queensl. XXIX, pp. 60–63, 1 text-fig.

Jullien, J. 1888. Bryozoaires. Miss. Sci. Cap Horn, 1882–1883, Zool. VI, pp. 1–92, 15 pls.

Kirchenpauer, G. H. 1869. Neue Bryozoen. Mus. Godeffroy Cat. IV, pp. xxv–xxxiv.

Kirkpatrick, R. 1888*a*. Polyzoa of Mauritius. Ann. Mag. Nat. Hist. 6, I, pp. 72–84, 4 pls.

—— 1888*b*. Polyzoa from Port Phillip. Ann. Mag. Nat. Hist. 6, II, pp. 12–21, 1 pl.

—— 1890*a*. Reports on the Zoological Collections made in Torres Straits. . . . Hydroida and Polyzoa. Sci. Proc. R. Dublin Soc. VI, pp. 603–626, 4 pls.

—— 1890*b*. Hydrozoa and Polyzoa from the China Sea. Ann. Mag. Nat. Hist. 6, V, pp. 11–24, 3 pls.

Lamarck, J. B. P. A. de. 1816. Histoire naturelle des Animaux sans Vertèbres, II.

Lamouroux, J. V. F. 1816. Histoire des Polypiers coralligènes flexibles. . . . Caen.

—— 1825. Quoy & Gaimard in Zool. Voy. Uranie, Paris, Polypiers flexibles, pp. 603–643, 7 pls.

Landsborough, D. 1852. A Popular History of British Zoophytes, London.

Lang, W. D. 1917. The Genotypes of Certain Polyzoan Genera. Quart. J. Geol. Soc. London, dec. 6, IV, pp. 169–174.

Levinsen, G. M. R. 1909. Morphological and Systematic Studies on the Cheilostomatous Bryozoa. Copenhagen.

Linnaeus, C. 1758. Systema Naturae, ed. 10, I.

Livingstone, A. A. 1926*a*. Report on the Polyzoa Collected on the Great Barrier Reef, Queensland . . . Rec. Aust. Mus. Sydney, XV, pp. 79–99, 4 pls., 1 text-fig.

LIVINGSTONE, A. A. 1926*b*. The Biology of North-West Islet, Capricorn Group. (F) Bryozoa. Aust. Zool. Sydney, IV, pp. 247–248.

—— 1927. A Check List of the Marine Bryozoa of Queensland. Rec. Aust. Mus. Sydney, XVI, 1, pp. 50–69.

—— 1928. Bryozoa from S. Australia. Rec. S. Aust. Mus. Adelaide, IV, pp. 111–124, 5 text-figs.

—— 1929. Bryozoa Cheilostomata of New Zealand. Vidensk. Medd. naturh. Foren. Kjøb. LXXXVII, pp. 45–104, 2 pls., 7 text-figs.

LONSDALE, W. 1845. Report on the Corals from the Tertiary Formations of North America. Quart. J. Geol. Soc. XLV, pp. 495–533, 28 text-figs.

MACDONALD, J. D. 1877. On a New Genus of Trematoda and some New or Little-known Parasitic Hirudinei. Trans. Linn. Soc. London, 2, I, pp. 209–212, 1 pl.

MACGILLIVRAY, P. H. 1868. Descriptions of some New Genera and Species of Australian Polyzoa; to which is added a list of Species found in Victoria. Trans. Proc. Roy. Soc. Vict. IX, pp. 126–148.

—— 1881. In McCoy, Prodromus of the Zoology of Victoria, dec. VI, pp. 27–46, 4 pls.

—— 1883. Descriptions of New or Little-known Polyzoa. II. Trans. Proc. Roy. Soc. Vict. XIX, pp. 130–138, 3 pls.

—— 1884*a*. Descriptions . . . V. Trans. Proc. Roy. Soc. Vict. XX, pp. 103–112, 3 pls.

—— 1884*b*. In McCoy, Prodromus . . . dec. IX, pp. 29–34, 2 pls.

—— 1885*a*. Descriptions . . . VIII. Trans. Proc. Roy. Soc. Vict. XXI, pp. 106–119, 5 pls.

—— 1885*b*. In McCoy, Prodromus . . . dec. X, pp. 13–31, 6 pls.

—— 1886. Descriptions . . . IX. Trans. Proc. Roy. Soc. Vict. XXII, pp. 128–139, 3 pls.

—— 1887*a*. Descriptions . . . XII. Trans. Proc. Roy. Soc. Vict. XXIII, pp. 179–186, 1 pl.

—— 1887*b*. A Catalogue of the Marine Polyzoa of Victoria. Trans. Proc. Roy. Soc. Vict. XXIII, pp. 187–224.

—— 1888. In McCoy, Prodromus . . . dec. XVII, pp. 241–253, 4 pls.

—— 1889. On some South Australian Polyzoa. Trans. Roy. Soc. S. Aust. XII, pp. 24–30, 1 pl.

—— 1890*a*. Descriptions . . . XIII. Proc. Roy. Soc. Vict. N.S. II, pp. 106–110, 1 pl.

—— 1890*b*. In McCoy, Prodromus . . . dec. XX, pp. 335–357, 2 pls.

—— 1890*c*. An Additional List of South Australian Polyzoa. Trans. Roy. Soc. S. Aust. XIII, pp. 1–7, 1 pl.

—— 1895. A Monograph of the Tertiary Polyzoa of Victoria. Trans. Roy. Soc. Vict. IV, pp. 1–166, 22 pls.

MAPLESTONE, C. M. 1882. Observations on Living Polyzoa. Trans. Proc. Roy. Soc. Vict. XVIII, pp. 48–51, 1 pl.

—— 1902. Further Descriptions of the Tertiary Polyzoa of Victoria, VII. Proc. Roy. Soc. Vict. XIV, pp. 65–74, 3 pls.

—— 1909. The Results of Deep-Sea Investigations in the Tasman Sea. I, 5, The Polyzoa. Rec. Aust. Mus. Sydney, VII, pp. 267–273, 4 pls.

—— 1910. On a New Species of *Cellepora* from the South Australian Coast. Proc. Roy. Soc. Vict. XXIII, pp. 39–41, 3 pls.

MARCUS, E. 1921*a*. Bryozoen. K. svenska VetenskAkad. Handl. LXI, 5, pp. 1–34, 2 pls.

—— 1921*b*. Indo-Pacifische Bryozoen aus dem Ryksmuseum in Stockholm. Ark. Zool. Stockholm, XIV, 7, pp. 1–23, 2 pls.

—— 1921*c*. Bryozoen von den Auckland- und Campbell-Inseln. Vidensk. Medd. naturh. Foren. Kjøb. LXXIII, pp. 85–121, 1 pl., 11 text-figs.

—— 1921*d*. Bryozoa von den Juan Fernandez Inseln, in Skottsberg, The Natural History of Juan Fernandez. Zool. III, pp. 93–124, 19 text-figs.

—— 1922. Bryozoen von den Aru Inseln. Abh. senckenb. naturf. Ges. XXXV, pp. 421–446, 2 pls.

MILNE-EDWARDS, H. 1836. Histoire naturelle des Animaux sans Vertèbres, Lamarck, ed. 2, vol. II.

—— 1838. Mémoire sur les Crisies, les Hornères et plusieurs autres Polypes. . . . Ann. Sci. nat. Paris, Zool. IX, pp. 193–238, 11 pls.

MONRO, C. C. A. 1931. Polychaeta, Oligochaeta, Echiuroidea and Sipunculoidea. Rep. Gt. Barrier Reef Exp. IV, no. 1, pp. 1–37, 15 text-figs.

NORMAN, A. M. 1864. On undescribed British Hydrozoa, Actinozoa and Polyzoa. Ann. Mag. Nat. Hist. 3, XIII, pp. 82–90, 3 pls.

—— 1903. Notes on the Natural History of East Finmark. Ann. Mag. Nat. Hist. 7, XII, pp. 87–128, 2 pls.

O'Donoghue, C. H. 1924. The Bryozoa collected by the S.S. "Pickle." Union of S. Africa Fish. and Mar. Biol. Surv. 3 (1922). Spec. Rep. X, pp. 1–63, 4 pls.

Okada, Y. 1921. Notes on Some Japanese Cheilostomatous Bryozoa. Annot. zool. Jap. X, 3, pp. 19–32, 7 text-figs.

d'Orbigny, A. 1850–52. Palèontologie Française. Terrains Crétacés, V.

Ortmann, A. 1889. Die Japanischen Bryozoen fauna. Arch. Naturgesch. Berlin, LVI, pp. 1–74, 4 pls.

Osburn, R. C. 1914. The Bryozoa of the Tortugas Islands, Florida. Pap. Tortugas Lab. Carn. Instn. V, pp. 183–222, 23 text-figs.

—— 1927. The Bryozoa of Curaçao. Bijdr. Dierk. Amsterdam, XXV, pp. 123–131, 7 text-figs.

Pallas, P. S. 1766. Elenchus Zoophytorum.

Philipps, E. G. 1899. Report on the Polyzoa . . . from the Loyalty Islands, New Guinea and New Britain. Willey's Zool. Res. IV, pp. 440–450, 2 pls.

Robertson, A. 1921. Report on a Collection of Bryozoa from the Bay of Bengal and other Eastern Seas. Rec. Ind. Mus. Calcutta, XXII, pp. 33–65, 11 text-figs.

Ritchie, J. 1911. On an Entoproctan Polyzoon (*Barentsia benedeni*) New to the British Fauna, with Remarks on Related Species. Trans. Roy. Soc. Edinb. XLVII, pp. 835–848, 1 pl.

Salensky, M. 1877. Études sur les Bryozoaires entoproctes. Ann. Sci. nat. Paris, Zool. V, no. 3, pp. 1–60, 4 pls.

Sars, M. 1835. Beskrivelser og Iagttagelser, Bergen.

Savigny, J. C. ? date. Déscription de l'Égypte. Polypes, pls. i–xiv, Paris.

Smitt, F. A. 1873. Floridan Bryozoa, II. K. svenska VetenskAkad. Handl. II, 4, pp. 1–83, 13 pls.

Solander, D. 1786. The Natural History of . . . Zoophytes collected . . . by the late John Ellis. London.

Sowerby, J. 1805. British Miscellany, London, VIII.

Thomson, W. T. C. 1858. On New Genera and Species of Polyzoa. . . . Nat. Hist. Rev. London, V, Proc. Societies, pp. 134–147, 5 pls.

Thornely, L. R. 1905. Report on the Polyzoa. Rep. Pearl Oyster Fisheries Gulf of Manaar, IV, pp. 107–130, 1 pl.

—— 1907. Report on the Marine Polyzoa in the Collection of the Indian Museum. Rec. Ind. Mus. I, pp. 179–196, 8 text-figs.

—— 1912. The Marine Polyzoa of the Indian Ocean from H.M.S. "Sealark." Trans. Linn. Soc. London, XV, pp. 137–157, 1 pl.

—— 1916. Report on the Polyzoa, in Hornell, Rep. Mar. Zool. Okhamandal in Kattiawar, II, pp. 157–165, 6 text-figs.

Waters, A. W. 1879. On the Bryozoa of the Bay of Naples. Ann. Mag. Nat. Hist. 5, III, pp. 28–43, 4 pls.

—— 1885. Cheilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia. Quart. J. Geol. Soc. London, XLI, pp. 279–310, 1 pl.

—— 1887. Bryozoa from New South Wales, North Australia, etc. I–III. Ann. Mag. Nat. Hist. 5, XX, pp. 81–95, 181–203, 253–265, 4 pls.

—— 1888. Supplementary Report on the Polyzoa. Rep. Zool. Chall. Exp. LXXIX.

—— 1889. Bryozoa from New South Wales, IV. Ann. Mag. Nat. Hist. 6, IV, pp. 1–24, 3 pls.

—— 1904. Bryozoa. Res. Voy. Belgica, pp. 1–113, 9 pls., 3 text-figs.

—— 1909. Rep. Mar. Biol. Sudanese Red Sea. The Bryozoa. I, Cheilostomata. J. Linn. Soc. London, XXXI, pp. 123–181, 8 pls.

—— 1910. *Op. cit.*, II. Cyclostomata, Ctenostomata, Endoprocta. J. Linn. Soc. London, XXXI, pp. 231–256, 2 pls.

—— 1913. The Marine Fauna of British E. Africa and Zanzibar. . . . Bryozoa. Cheilostomata. Proc. Zool. Soc. London, pp. 458–537, 10 pls.

—— 1918*a*. Bryozoa of the Cape Verde Islands. J. Linn. Soc. London, XXXIV, pp. 1–45, 4 pls.

—— 1918*b*. Some Mediterranean Bryozoa. Ann. Mag. Nat. Hist. 9, II, pp. 96–102, 1 pl.

—— 1925. Ancestrulae of Cheilostomatous Bryozoa, III. Ann. Mag. Nat. Hist. 9, XVI, pp. 529–545, 2 pls.

Whitelegge, T. 1889. List of the Marine and Fresh-water Invertebrate Fauna of Port Jackson and the Neighbourhood. J. Roy. Soc. N.S.W., pp. 163–323.

INDEX

(The principal references are in heavy type.)

DESCRIPTION OF PLATE I.

A, *Petralia litoralis*, Livingstone MS., sp. n. Type-specimen. × c. 10. Photograph by Mr. Livingstone.
a., Avicularium.

B, *Vittaticella buskii* (Wyv.-Thom.), from the Hong-Kong Manila Cable. Natural size.

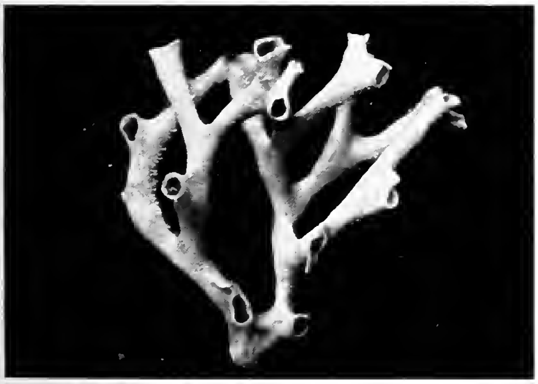
C, *Schizomavella australis* (Haswell). Natural size.

D, *Microporella mutabilis*, sp. n. Type-specimen. Natural size.

E, *Retepora monilifera* var. *benemunita* (Busk MS.), var. n. Type-specimen. Natural size.

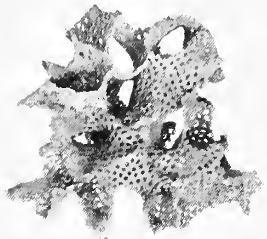
A

B



C

D



E

[*Adlard & Son, Ltd., Impr.*

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 13

GORGONACEA

BY

SYDNEY J. HICKSON, F.R.S.

WITH TWENTY TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1932

Price Five Shillings

[*Issued 26th November*, 1932]

Made and printed in Great Britain

GORGONACEA

BY

SYDNEY J. HICKSON, F.R.S.

WITH TWENTY TEXT-FIGURES

CONTENTS

1. INTRODUCTION.

THE naturalists of the expedition have reported that Gorgonids are rare on the Barrier Reef (Yonge, 1930, p. 133), and that only two species, a *Juncella* and a *Melitodes*, could be found at Low Isles, and that these were apparently confined to shaded or overhanging surfaces on the seaward slope and formed no part of the ordinary surface fauna (Stephenson, 1931, p. 71). The collection sent to me confirms these reports as a general statement of fact, but there is one locality investigated which bears a very rich fauna of Gorgonacea.

In the Penguin Channel no less than 42 specimens were obtained from two stations, and these may be referred to 9 genera and 15 species. The short and narrow " Penguin " Channel lies between Snapper Island and the mainland. It is about 7 miles N.W. of Low Isles, and is 13–14 fathoms deep, with a rocky bottom. An important feature of this channel, which may account for the fact that it is two or three fathoms deeper than the

sea between Snapper Island and Low Isles and for its clean-swept bottom, is that the flood tide flows from south to north directly through the channel and that the ebb tide creates an eddy round the island, so that there is a flow of water in the same direction during the ebb.

A flow of water therefore in one direction over a rocky bottom seems to be favourable to the growth of Gorgonacean corals.*

A strange contrast to this is to be found in Panama Bay, where the Gorgonacea flourish abundantly in an open and very muddy sea (Hickson, 1928, p. 326).

There are no species common to the two regions, but in both there are Gorgonians with lax ramification, and with flabellate ramifications with anastomoses and without anastomoses. The bushy form of ramification which is very common among the Gorgonacea of Panama Bay is not represented in any of the specimens collected in the Penguin Channel.

Our knowledge of the Gorgonacean fauna of the Barrier Reef is very scanty. Ridley (1884) described 22 species collected between Torres Straits and Port Curtis, and of these 14 were Holaxonia and 8 Scleraxonia.

In this report I have recorded 19 species, of which 17 are Holaxonia and only 2 Scleraxonia. Six of these species are probably identical with species described by Ridley. All the others, with the exception of *Isis hippuris* and *Melitodes ochracea* previously described by Saville Kent, have not been recorded from this region.

Owing to the great difficulty of identifying the species of some of the genera of Gorgonacea, to be discussed later, these figures represent opinions rather than facts. The most interesting point in the statement is that Ridley recorded 8 species of Scleraxonia, and that there are only two in this report. It was a surprise to find in the collection no representatives of such genera as *Siphonogorgia*, *Solenocaulon*, *Alertigorgia*, *Mopsella* and *Acabaria*. The species described by Ridley as *Leptogorgia australiensis* (since referred by Kükenthal [1919, p. 854] to the genus *Pseudopterogorgia*) seems to be very common on some parts of the reef, but is not represented in the collection.

Some of the species presented no difficulty in determination. *Isis hippuris* and *Melitodes ochracea* can be recognized at once by several distinguishing characters and seem to show little variation. Most of the others in the collection, however, could be given generic and specific names only with some doubt, and after long and tedious research in the vast literature of the subject. These difficulties have arisen in consequence of the overlapping in characters of the families and the genera into which the Holaxonia have been artificially separated, and to the description of many new species on quite insufficient grounds.

In a previous paper (1930, p. 248) I have pointed out that, apart from the family Isididae, which stands by itself, the families of the Holaxonia, which are generally recognized cannot be separated from one another by any one clearly defined character nor by two or more characters in combination. Some species referred to the Plexauridae, for example, have characters which are almost identical with those of the Gorgoniiade (Hickson, 1928, pp. 339, 340), and others have characters almost identical with those of

* There were only two dredging stations in Penguin Channel, Station IX, 22.ii.29, 12–14 fathoms, in a clean pit and on mud at sides; six dredges about 20 mins. each: and Station XII, 24.ii.29, 10–15½ fathoms, rock and shell gravel, mud on edges of the pit; five dredges of about 20 mins. each. To avoid repetition the numbers only of these stations are referred to in the text.

the Muriceidae. Some of the species of the genus *Plexauroides*, usually included in the family Plexauridae, appear to be identical with species of the Muriceid genus *Echinogorgia* (see p. 498), and there are no characters which have yet been described to distinguish *Euplexaura robusta* from the Muriceid genus *Discogorgia* (see p. 474).

The result has been that some species of a genus have been redescribed as " new species " of a different genus and attributed to a different family.

The rapid multiplication of generic names which has taken place of recent years, based, in many cases, on some slight variation in one character (*e. g.* the spicules), has led to unnecessary confusion and difficulty.

The number of supposed new species, many of which have been very inadequately described, has increased to such an extent that the task of attempting to determine a specimen from a new locality is almost overwhelming. The pronounced tendency to increase the number of genera and species in this group of families is due, in no small measure, to faith in the size and detailed characters of the spicules as a guide to generic and specific diagnosis.

There can be no doubt that in some cases the spicules of Alcyonaria (*e. g.* the club-shaped spicules of *Juncella*, the " torches " of *Eunicella*, the scales of many Primnoidae, etc.) are very valuable guides for the distinction of genera or species ; but in others they are so variable, both in the individual and the species, that great discretion is needed in the use of them for systematic purposes. An investigation of the specimens of the genera *Plexauroides* and *Echinogorgia* in this collection lends support to the view that the spicules are far more variable than is usually supposed.

There are 14 specimens of these closely related genera from the Penguin Channel. They all possess a superficial layer of spicules of the type known as " Blattkeulen " (see p. 481). An examination of preparations of all these specimens shows that no two of them were exactly alike as regards the spicules of the coenenchym, and not one of them is exactly in agreement with the description of the spicules of any of the numerous species of the genera hitherto described.

If the principles of classification used by many previous writers on the subject had been adopted, I should have had to propose 14 new species based on the examination of one specimen of each species. To suppose that the naturalists of the Expedition in the course of two days collected only one specimen of each of 15 distinct species in this very small channel is, however, absurd.

Kükenthal (1910) and Broch (1916) have described 8 new species of the genus *Plexauroides* from Sharks Bay and Cape Jaubert in W. Australia at approximately the same depth. These two localities are less than 200 miles apart. There were 3 specimens of one species, but only one specimen of each of the others. Here, again, it seems very remarkable that only one specimen of each of 7 species, which are supposed to be distinct, was obtained in such a limited geographical and bathymetrical range.

Other examples could be given similar to the above, all of which indicate that many of the new species must be only local varieties of a much smaller number. In some Gorgoniidae the spicules are of the same general form and maximum size throughout the whole colony, but when spicules of different specimens of the same species are examined, small but quite appreciable differences are found (Hickson, 1928, pp. 374, 377, 387). The case of *Gorgonia stenobrochis* was of particular interest, because it is quite distinct from the other species of this genus and 7 specimens from the same pool were examined. If these

specimens had been found in different localities, and reliance had been placed on small differences in the spicules without consideration of other characters, several new species might have been proposed.

It is the same with the Muriceids. Many of the genera have spicules of a definite type, such as the " Blattkeulen " of *Echinogorgia*, the dagger-shaped spicules of *Acanthogorgia*, the disc-shaped spicules of *Bebryce*, etc., but the exact size, the details of structure, the tuberculation and other characters vary in every species, and to some extent in every individual.

There are two main influences that determine the size and appearance of the fully-formed spicule. The force of heredity which gives the spicule the generalized type of the genus or species, *i. e.* the club, the spindle, the capstan, the " Blattkeule," etc., and the external forces which determine the exact size and the final detailed form of such processes as tubercles, spine, foliate expansions, etc.

Woodland (1905, pp. 16, 17), in his valuable study of the development of the spicules of *Alcyonium*, laid down two principles: (1) That the growing spicules are subject to an aggregate of tendencies which tend to produce irregularities of form. (2) That the extension of a growing body into a surrounding resistant body is most easily effected by the protrusion of more or less acute processes which, in virtue of their acuteness, are best able to cleave a passage.

That the form of the spicules of certain sponges is also influenced by external forces was shown in an interesting paper by Dendy and Nicholson (1917, p. 573). On these principles the ultimate structure of an individual spicule in such a position as the surface of the verrucae or coenenchym of the Muriceidae, where the spicules are crowded together, depends upon its site and its relation to neighbouring spicules.

The spicules round the aperture of a verruca, for example, may bear a spine, *e. g. Acanthogorgia*, which is much more prominent than it is on the spicules at the base of the verruca, and it is very tempting to assume that the latter correspond with a developmental stage of the former. The study of the spicules of young verrucae suggests that they are (Gordon, 1926), in some cases, but there can be no doubt that the development of any spicule is influenced to some extent from the earliest stages by the position it occupies in relation to other spicules and environmental forces.

The process of development of a spicule cannot be studied in prepared material in the same way as the development of a frog can be observed from the live egg to the live tadpole stage; it is only an inference, which may be misleading, that the smaller spicules in a preparation represent earlier stages in the development of the larger ones.

But even if we cannot trace the development of a particular type of spicule in detail, the study of smaller spicules of the type often affords valuable evidence of the value of the full-grown spicule for the determination of specific characters (*cf.* p. 481), as they may correspond with a developmental stage in the growth of the spicule.

If there is some modification of the details of the structure of spicules due to the influence of immediate surroundings, it should be particularly noticeable in those parts of the spicules of the Muriceidae which project from the surface of the coenenchym. Such processes have not to force their way through the dense coenenchym, but are subject to the varied influences of the currents of water and its contents which pass over the surface of the Alcyonarian and other conditions of their site.

When a large number of the spicules of a genus bearing such spicules is examined, a

very remarkable range of variation is seen as regards the detailed structure of the processes, such as the arrangement of the leaves, the number of tubercles, the length of the spines, etc. It is, indeed, difficult to find two spicules that are exactly alike.

This variability of the spicules in the Gorgonacea does not seem to have been usually recognized in systematic work, with the result that several new species have been described, based on the minor and variable characters of one specimen.

In the key plan of the species of *Echinogorgia*, for example, given by Kükenthal (1924, p. 198), the difference between three species of the genus is that in *E. complexa* the leaves of the Blattkeulen are in rows, in *E. furfuracea* they are radial, and in *E. ridleyi* in concentric circles.

On an examination of a large number of spicules from a single specimen referred to the species *E. furfuracea* in the collection, all three of these arrangements of the leaves can be found, as well as many others that are more irregular.

The value of the mode of ramification, as a character of the species, is difficult to determine, and particularly so as regards small specimens 100 mm. or less in height.

There can be no doubt that external influences, such as the strength and direction of the sea current, neighbouring corals and other zoophytes, etc., must influence the detailed growth of the branches ; but, in my experience, the general forms of unbranched, or lax, or flabellate or reticulate ramifications are good characters for systematic determinations. The two small forms of *Ctenocella* described later (p. 509) afford an interesting confirmation of this view.

The entire lack of knowledge of the development of the colonies of these Alcyonaria renders the correct identification of small colonies very difficult. An unbranched specimen 50 mm. high might have remained unbranched like a *Juncella juncea*, or it might have given rise to a flabellum with or without anastomoses.

There are two specimens referred to the species *Echinogorgia furfuracea* in the collection, which are alike in other respects, but the larger one (160 mm. high) has anastomosing branches, and the smaller (100 mm. high) has no anastomoses between the branches. The larger specimen of *Plexauroides rigida* (180 mm. high) has a lax method of branching ; the smaller one (70 mm. high) is unbranched. An investigation, which could only be carried out when a large number of specimens of the same species from the same locality are available, to determine the size or age at which the young forms assume the characteristic form of branching of the adult, would be of great value, and would probably lead to a considerable reduction in the number of redundant species.

In this collection ten stems 2·5–40 mm high arising from a common base of *Euplexaura robusta* (Spec. D) are unbranched, but a stem 65 mm. in length has branches in the same plane (see p. 471 and Text-fig. 1).

Colour.—The investigation of the colour of the specimens in this collection confirms the opinion I expressed (1928, pp. 360 and 399) in the description of the species of *Muricea* and *Leptogorgia* from Panama, that colour may be a fixed character and of considerable value in systematic work.

There are various shades of red, passing from pale pink to coral red, and to orange and yellow, which may be interchangeable, but the distinction between coloured and white or colourless seems to be fixed. The pigment which colours the spicules is either present or absent. When present it may be confined to the spicules at the surface of the coenenchym which are fully exposed to the light, or it may be present in all the spicules

of the colony, but the species without any colour in any of the spicules seem to be distinct from those with colour in some or all of the spicules.

The colour of living Alcyonaria is often different to the colour of preserved specimens of the same species. This is due to the presence of soluble pigments in the coenenchym, and of these we have very little knowledge at present.

The evidence seems to be conclusive that in several of the genera of the Gorgonacea there is considerable variation in the characters which are used for systematic purposes, and the of idfficulty distinguishing true species from mere varieties is almost insuperable. The number of specimens from any locality collected by the research expeditions is usually quite insufficient to throw any light on the matter. Moreover a complete account of the characters of the fully expanded polyps is impossible when the specimens sent home for examination are completely contracted. A study of the size, structure and armature of the anthocodiae would probably yield very valuable results.

The time and resources of these expeditions are not usually sufficient to provide expanded material of the kind required on a large scale, but an intensive study of one species or group of varieties in one locality would give us a very welcome addition to our knowledge of this group.

The possibility of hybridization must always be borne in mind, and therefore a record of the gonads should always be made, and the date on which the specimens were collected. The few facts that have been collected seem to indicate that most of the Gorgonacea of the Penguin Channel spawn at the same time of the year, and that therefore hybridization is not impossible. If it can be shown that two closely related forms breed at different times of the year and hybridization is thus rendered impossible, there would be one good reason for regarding them as distinct species.

Gonads.—Most of the specimens in the collections were examined by means of whole mounts decalcified and cleared in oil, to determine the size and sex of the gonads if they were present.

By this method gonads 0·05 mm. in diameter can be easily seen and their size and sex determined. Series of sections show in some cases gonads of still smaller size, but it seemed to me unnecessary, for my purpose, to devote so much time to cutting sections of all the specimens as this would have involved. In the Alcyonarian colonies the sex and stage in oogenesis or spermagenesis is usually the same throughout, so that a sample taken from any part or branch except the growing tips gives the sex and state of maturity of the colony as a whole. I have not discovered any case in which different parts of a colony were not of the same sex, and in these Gorgonians from the Barrier Reef there were no examples of hermaphroditism nor of viviparity. It is possible that some branches of a colony that bears gonads elsewhere may be barren, and that some of the specimens in which no gonads were observed may not be barren throughout. That is a possibility which should not be lost sight of in the following discussion of results.

The specimens collected in the Penguin Channel on 22nd and 24th February, 1929, are 42 in number, and they are referred to 14 species in this report. Of these, 33 were examined for gonads; 6 duplicates of *Euplexaura robusta* and 3 duplicates of *Muricella tenera* were not examined. In 13 out of the 33 specimens examined no gonads were observed.

Of the 20 specimens with gonads, 14 are male and 6 female. In only one specimen (*Plexauroides praelonga*) is the gonad nearly mature; in all the others they are immature,

varying from 0·1 to 0·3 mm. in diameter. There are 8 specimens referred to 6 species which were dredged outside the Penguin Channel. *Suberogorgia appressa* from the Pasco Reef collected in March, *Acanthogorgia studeri* from the Papuan passage also in March, *Melitodes ocharcea* and *Isis hippuris* from the Low Isles in February and May, were apparently all barren. The specimen of *Muricella perramosa* from the Linden Bank collected in November had small male gonads, and *Isis hippuris* from Lizard Island in July, ripe male gonads. A male specimen of *Ctenocella pectinata* taken in February on the Wentworth Reef had the gonads nearly ripe, and 0·5 mm. in diameter. As a small female specimen of the same species collected on the following day in the Penguin Channel had relatively large ova (0·4 mm.), it may be that this species spawns earlier than the other species of this part of the reef.

As the number of observations is very small, no definite conclusions can be drawn from these facts, but they seem to indicate that most of the Gorgonians of the Penguin Channel are in approximately the same sexual stage in the month of February, and that therefore they spawn at some later time. There is no evidence at present as to the time when they do spawn ; but if I were asked my opinion, I should say probably June or July.

Our knowledge of sexual questions in the Alcyonaria is very meagre, but in some species several months (six months in the case of *Alcyonium digitatum*) elapse from the time when the gonads are first visible to the naked eye until they are mature. In this connection it is of some interest to note that one specimen of *Isis hippuris* collected off Lizard Island on 3rd July was sexually mature with gonads 0·45 mm. in diameter.

There is no evidence as to the size or age at which these Alcyonarians reach sexual maturity. The smallest specimen in the collection of *Euplexaura robusta* (specimen x), was a male with testes only a little smaller than those of other specimens of the same species.

Of the two small specimens of *Ctenocella pectinata* from Penguin Channel, one was a female with comparatively large ova (0·4 mm.). The very small (55 mm. high) specimen of *Echinogorgia sasappo* has male gonads as large as those of the larger specimen.

My thanks are due to Prof. Stanley Gardiner for giving me facilities to work in the Zoological Department in the University of Cambridge, to Capt. Totton, Dr. A. Hastings and Mr. Robson for assistance in identifying specimens in the British Museum, to Dr. S. Manton for information concerning the localities on the reef, and to Miss J. Gardiner for drawing many of the illustrations.

2. LIST OF SPECIES.

The following is a complete list of the species in the collection :

Sub-Order Scleraxonia.

Family *Suberogorgiidae.*

Suberogorgia appressa, Nutting. 1 specimen.

Family *Melitodidae.*

Melitodes ochracea, L. 2 specimens ; P.

Sub-Order Holaxonia.

Family *Isididae.*

Isis hippuris, L. 3 specimens.

Family *Plexauridae.*

Euplexaura robusta, Kükth. 13 specimens ; P.

Family *Muriceidae.*

Muricella perramosa, Ridley. 1 specimen.
Muricella tenera, Ridley. 8 specimens ; P.
Echinogorgia sasappo, Esper. 2 specimens ; P.
Echinogorgia furfuracea, Esper. 2 specimens ; P.
Echinogorgia sphaerophora, Kükth. 1 specimen ; P
Echinogorgia reticulata, Esper. 2 specimens ; P.
Echinogorgia umbratica, Esper. 1 specimen ; P.
Plexauroides rigida, Kükth. 2 specimens ; P.
Plexauroides praelonga var. *typica*, Ridley. 2 specimens ; P.
Plexauroides praelonga var. *cinerea*, Ridley. 2 specimens ; P
Echinomuricea indo-malaccensis, Ridley. 1 specimen ; P.
Paramuricea (?). 1 specimen ; juv. ; P.

Family *Acanthogorgiidae.*

Acanthogorgia studeri, Nutting. 1 specimen.

Family *Gorgonellidae.*

Juncella gemmacea, Val. 2 branches ; P.
Scirpearia elongata, Pall. 1 specimen ; P.
Ctenocella pectinata, Pall. 3 specimens ; P.

Note.—The letter "P." at the end of the line signifies that the species was dredged in the Penguin Channel.

3. EPIZOITES.

Most of the Alcyonaria in the collection are quite clean, but on some there is a rich fauna and flora of epizoic organisms. None of these seem to be destructive in nature, but in most cases are confined to the dead or dying stems and branches, taking advantage of the firm support of the exposed axis.

In a few specimens there is a small growth of sponge over the coenenchym that looks normal, but these are the only cases in which the epizoites appeared to have a smothering effect.

Attached to an *Echinogorgia reticulata* (F) were two specimens of the Pelecypod *Pteria marmorata*, each about 65 mm. in length. Another specimen of the same size was attached to a specimen of *Muricella tenera* (G), and two small ones (16 and 18 mm. in length) were

attached to another specimen of the same species of *Muricella* (Q). These molluscs modified to some extent the normal ramification, but did not affect to any serious degree the general well-being of the colony (Text-fig. 4). Attached to the bare axis at the base of the stem and branches of the *Echinogorgia reticulata* (F) there are growths of Zoanthids, Sponges, Polyzoa, Hydrozoa, and a few small specimens of the interesting Tunicate *Didemnum grande* of Herdman, whose minute, densely crowded calcareous spicules give it the superficial appearance of an encrusting Foraminifer. A small simple Ascidian (15 mm. in height) was found on some of the branches.

Mixed with this varied fauna on the stem are some long filaments which I believe are algae. Among a similar fauna attached to the stem of the specimen of *Echinomuricea*, I found some small colonies of *Rhabdopleura* with the zooids beautifully preserved. The *Pteria* shells attached to these Gorgonians also bear a rich epizoic fauna, including two species of special interest. One is a fine specimen of the encrusting Polyzoon *Petralia vultur* var. *serrata*, Livingstone, and the other a diminutive Alcyonarian without spicules which I think should be referred to the species *Clavularia margaretiferae* of Thomson and Henderson.

4. DESCRIPTION OF SPECIES.

Sub-Order SCLERAXONIA.

Family Suberogorgiidae.

Suberogorgia appressa, Nutting.

An incomplete specimen from Station XXIV, 16½ fathoms, ¾ mile N.W. of Pasco Reef (13.iii.29) has close agreement with Nutting's (1911, p. 28) species founded on specimens from Makassar (32 metres) and Aru Island (13 metres). It has no base of attachment, and may be only a part of a much larger specimen. There is a main branch about 150 mm. in length giving off, from one side only, six long secondary branches, of which one is 100 mm. in length. From these characters it is probable that the whole colony was a flabellum with very long terminal branches.

All the branches are slightly flattened and there is a well-defined groove running along the middle line of the flatter surfaces on both sides. The greater diameter of the main branch is 4 mm., and of the terminal branches about 2·5 mm. The verrucae are low mounds where the polyps are completely retracted, but scarcely visible where the polyps are fully expanded. The polyps are very small. The expanded anthocodiae have a body 1 mm. in length and 0·45 mm. in diameter. The tentacles are difficult to measure, but when fully expanded are about 0·65 in length.

The colour of the coenenchym is brownish red, approximately chestnut colour; the anthocodiae are quite colourless.

The spicules of the coenenchym are stout girdled spindles showing very little variation in size or form. They are approximately 0·15 mm. in length by 0·06 mm. in greatest breadth, including the tubercles. There are usually six whorls of tubercles on each spicule, but exceptionally eight whorls may be counted. A few spicules in a preparation are 0·18 mm. in length.

Their colour is orange-yellow by transmitted light, but decidedly pinkish by reflected light. The armature of the anthocodiae agrees so closely with that of the type that

Nutting's description may be quoted : " The entire dorsal surface of the infolded tentacles is covered with a complete armour of flattened longitudinal spicules or bar-like forms, there being numerous longitudinal series in each tentacle." All these spicules are quite colourless.

Gonads were not observed in this specimen.

A section of the axis shows a large number of spicules of the same size, form and colour as the spicules of the coenenchym embedded in a mass of colourless smooth branching fibres or rods. There is no central core, and no canals passing longitudinally through the substance of the axis.

When the axis is decalcified the girdled spindles have disappeared, and there is left a spongy mass of branching and anastomosing fibres. These fibres are about 0·03 mm. in diameter and do not differ in that respect from the fibres of the undecalcified axis, but they differ materially from them in appearance, having a much less sharp outline, and seem to be hollow tubes rather than solid fibres. In the undecalcified axis they are obviously very brittle, breaking into sharp angled blocks as the razor passes through them. For these reasons it seems certain that the horny substance of which they are composed is heavily calcified.

The axis agrees in general characters with the axis of *Sclerogorgia* described by Kölliker (1865, p. 144), and of *Suberogorgia appressa*, described by Kükenthal (1919, p. 685), but differs from them in the character that the girdled spindles in the axis are coloured. No mention is made by previous authors concerning the calcification of the horny matrix of the axis.

The type species of this genus is *Gorgonia suberosa*, Pallas, from the " Indian Ocean." Kölliker (1865) gave figures of the spicules of this species under the name *Sclerogorgia suberosa*, and a description of the axis of his new genus. Ridley correctly transferred the species to Gray's genus *Suberogorgia*. It was said to inhabit the coast of Africa and the Indian seas.

Studer (1878, p. 666) attributed a specimen from the N.W. coast of Australia, and Ridley (1884, p. 349) specimens from Torres Straits and Alert Island to this species. There is, however, no good description of the characters of the type, and there may be some doubt whether the W. Australian specimens are really identical with the type from the Indian seas.

If we can trust Kölliker's identification of the type-species, its spicules are of the same size and character as those of our specimen, but of a paler yellow colour, and the axis differs in so far as the included spicules are colourless. Nutting's species, *S. appressa*, is better known, and although it is difficult to distinguish it from the type-species by any very pronounced characters, it is probably, on the ground of distribution and on the general appearance, as shown in the illustrations in Nutting's Plate V as compared with Esper's Plate 49, a distinct species.

In Kükenthal's key plan of the species the difference between the two species is said to be that the branching of *S. suberosa* is dichotomous and of *S. appressa* lateral. A glance at the two illustrations of the types of these species referred to above shows that no distinction can be drawn between them in this respect. The terminal branching of *S. appressa* has exactly the same appearance of dichotomy as *S. suberosa*. Ridley's specimen of *S. suberosa* from Torres Straits, in the British Museum, has a pale orange-yellow colour and the terminal branches are relatively thicker than those of the specimen described above.

Family Melitodidae.

Melitodes ochracea, L.

Two specimens of this common and well-known species were obtained, one from Station 1 of the general survey of Low Isle (19.v.29), and the other from Penguin Channel, Station XII (24.ii.29). They are both irregularly fan-shaped in growth, and measure 100 mm. by 90 mm. and 180 mm. by 90 mm. respectively.

They exhibit the characteristic features of the species, a thick stem (13 mm. in diam.) with moderately thick secondary branches shading off into numerous very slender (1·5 mm.) terminal twigs. In the secondary branches the swollen nodes are almost spherical in shape (6 mm. in diameter), and the internodes, very variable in length, are 3 mm. in diameter. The maximum length of an internode is about 6 mm., but most of them are much shorter.

There are a few anastomoses in the middle and basal regions of the flabellum.

The only character by which the specimens do not fully agree with the definition of the species given by Kükenthal (1924, p. 62) is that the stem and main branches are almost cylindrical, not oval in section (abgeplattet). The verrucae are small (*ca.* 0·75 mm. in diameter), and in most of them the aperture is wide open, showing the infolded tentacles. They are very conspicuous owing to their bright orange colour.

Most of the verrucae are on one side of the flabellum, and on many of the branches they are arranged in two lateral rows, with a few scattered verrucae between them on a median bare track. On the opposite surface of the flabellum there are only a few scattered verrucae.

The colour of the coenenchym is a dark purplish-red. The nodes and internodes of the axis have the same colour. The anthocodiae are yellow.

The spicules of the coenenchym are spindles and clubs with coarse, blunt tubercles irregularly scattered over their surfaces, and between the typical spindle and the typical club there are many intermediate forms. The largest of these spicules are 0·12 mm., but the majority are only 0·1 mm. in length. The armature of the anthocodiae agrees with the description given by Kükenthal; the thin long yellow spicules of the crown that surrounds the base of the tentacles reach a length of 0·15 mm.

There were no gonads in either of them.

There can be little doubt that these specimens belong to the same species as the *Isis ochracea* of Linnaeus and the older writers. Kölliker (1872) described the spicules of the species under the name *Melithaea ochracea.* The generic name of the genus was changed to *Melitodes* by Verrill in 1864. Since that time many new species of the genus have been described.

M. ochracea was recorded from the Barrier Reef by Saville Kent. *M. esperi* from Torres Straits by Wright and Studer (1889, p. 179), and *M. albitincta* by Ridley (1884, p. 359) from Queensland.

There seems to be very little difference between *M. esperi* and *M. ochracea* except in the size of the spicules of the coenenchym. According to Wright and Studer, they are nearly twice as large (0·24 mm.) in *M. esperi* as they are in *M. ochracea.*

According to Kükenthal's key plan (1924, p. 55), *M. ochracea* differs from *M. squamosa* of Nutting from the Malay Archipelago in having flattened branches. The flattening of

the branches of these Alcyonaria is probably caused by special external conditions of the locality in which they grow, and as a character has no value for the diagnosis of species.

In this case it is very striking how closely the specimens from the Barrier Reef agree with the description of the species by previous authors in all the principal characters except this one, and if the flattening of the branches is sound as a specific character, the new species it would be necessary to make for them would differ from *M. ochracea* in this character alone.

Kükenthal (1919, pt. 2, p. 150) considers that Nutting's (1911, p. 38) *Birotularia splendens* from the Kei Islands is identical with *M. ochracea*. The coenenchym spicules of this species are not only much smaller, but of quite a different type to any I have seen in *M. ochracea*, and, moreover, the characters of the ramification seem to be different in the two species. It may be a matter of opinion whether Nutting was justified in making a new genus for his species, but it certainly differs very distinctly from *Melitodes ochracea*.

Sub-Order HOLAXONIA.

Family Isididae.

Isis hippuris, L.

Two complete specimens and some fragments of this well-known and widely distributed species are in the collection :

One from Lizard Island, Reef A (3.vi.29), is 200 mm. high, the other from Three Isles (1–15.v.29) is 150 mm. high, and the fragments are from Low Isles A 2 (date ?).

The Three Isles are about 75 miles north of Low Isles and Lizard Island about 30 miles further north, in latitude 14° 40′ S.

The species is said to be common at the anchorage in Low Island (Stephenson, 1931, p. 82). Its very beautiful jointed axis and very thick coenenchym distinguish it at once from any other kind of Gorgonian on the Reef.

There is an excellent account of the history and anatomy of the species by Simpson (1909, p. 180), and, as my own observations on its structure agree very closely with his description, there is no need for me to describe those specimens in detail.

The specimen from Lizard Island collected in July bears numerous ova (0·45 mm. in diam.), which have the appearance of being nearly mature. The specimen from Three Isles collected in May is barren, and I found no gonads in the fragments from Low Island.

Family Plexauridae.

Euplexaura robusta, Kükenthal.

There are twelve specimens of this species from the Penguin Channel (8 from Station IX and 4 from Station XII). Of the specimens from Station IX, 6 consist of a single stem springing from a relatively small base of attachment; 2 consist of a wide base of attachment giving rise to several stems. The former range from 42–120 mm. high, and the branches, when present, are almost exactly in one plane. The smallest is unbranched; the largest has ten branches, some of which give off secondary twigs. There are no anastomoses. The branches in all the specimens are rather thick, the terminal

ones being in many cases 3–4 mm. in diameter. Most of the branches have a knobbed extremity. In one specimen (102 mm. high) there are no verrucae on the base of attachment, nor on the proximal part of the stem, for a distance of 30 mm. from the base. On all the others the base bears a few small verrucae.

The other two specimens from this station are of special interest. One of them (D) consists of a large base spreading over a considerable area of an oyster shell (Text-fig. 1). It is irregularly circular in outline and about 40 mm. in diameter. On this base there are numerous irregularly scattered verrucae. It supports one branched stem (65 mm. high) and ten unbranched stems (2·5–40 mm. high). The other one (A) is also attached to an

TEXT-FIG. 1.—*Euplexaura robusta*. Specimen D, showing a very large spreading base of attachment bearing verrucae. From the base arise one branched and several unbranched stems. Nat. size.

oyster shell and has a spreading base 30 mm. in diameter, which bears two stems about 15 mm. apart, one 30 mm. high, the other, which is bifurcated, 40 mm. high.

The four specimens from Station XII are 50–80 mm. high, and all bear branches, but in three of them the branching is decidedly not in one plane, but quite irregular and in all directions. In the fourth specimen (70 mm. high) the branching is as clearly in one plane as in the specimens from Station IX.

At first sight the verrucae seem to be smaller and rather wider apart than in the larger specimens from Station IX, but in these respects they do not differ from the smaller specimens from that station, nor from some of the branches of the larger specimen.

More detailed examinations of structure leave no doubt that the specimens from the two stations belong to the same species.

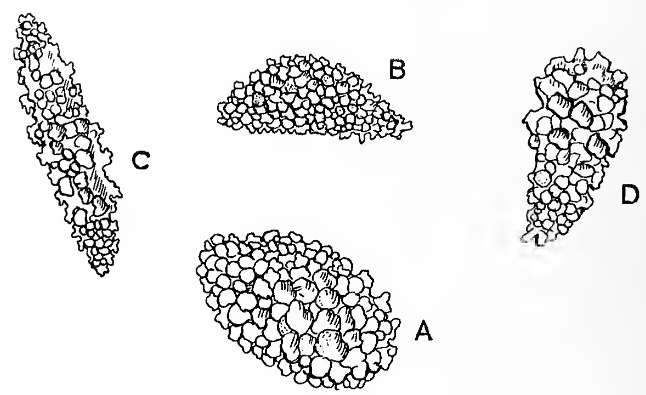
The verrucae are prominent dome-shaped structures, with eight triangular lobes, bent inwards at the upper end, and when fully grown are 1 mm. in diameter at the base and about 0·75 mm. in height. The whole surface of the verrucae, including the lobes, is heavily armed with spindle-shaped spicules.

In most of the specimens from both localities there are several smaller verrucae, with an aperture in the centre of the dome, which are not lobed as in the full-grown verrucae, and many forms of intermediate size with small lobes can be found.

The coenenchym between the verrucae is protected by a layer of close-set spicules, ovals, discs and other forms fitting close together to form a continuous shield.

The colour of all the specimens is a dull grey.

Spicules.—The outer layer of the coenenchym is armed with a continuous coat of thick discs or oval-shaped spicules, reaching a maximum size of 0·4 mm. in diameter and 0·45 × 0·2 mm. Many of these spicules are plano-convex in optical section, the outer convex surface having longer tubercles than the inner flat side (Text-fig. 2).



Text-fig. 2.—*Euplexaura robusta.* Four spicules of the coenenchym. a, Surface view of a disc. b, Side view of another disc. c, A typical spindle. d, An intermediate form. × 100 diam.

Beneath this layer the coenenchym is packed with thick spindle-shaped spicules, most of them about 0·2 mm. in length, but some much larger. They are not arranged in definite layers, but in a thick terminal branch there are four or five of these spindles between the axis and the outer layer. In many species of this genus the spindles have an equatorial band free from tubercles. I have not seen one of this type in my preparations.

The armature of the anthocodiae agrees exactly with the description and figures of the type by Kükenthal (1909, p. 18). There is a crown of two or three rows of bent spindles on which stand eight groups of three or four pairs of converging spicules to form the points. These spicules have the same size and form as those of the type.

Neither in the original description nor in the definition of the species in ' Das Thierreich ' does Kükenthal refer to any further armature of the polyps.

In the description of *Euplexaura flabellata* from W. Australia, Broch (1916, p. 42) states that the tentacles are richly encrusted with small, feebly tuberculated rod-shaped spicules. This species was considered by Kükenthal to be identical with *E. robusta,* and Thomson and Dean (1931, p. 198), agreeing with this identification, refer to the well-armoured tentacles of their specimen from the coast of Ceram.

The tentacles of the specimens from the Penguin Channnel are densely pigmented, and

it is difficult to clear them in oil. but dissections of the retracted anthocodiae have not revealed any trace of these small spicules in the tentacles.

The axis is brown and flexible in the terminal branches. but almost black in the main stem near the base. On treatment with acid the axis gives off a slow effervescence of very small bubbles, proving the presence of some calcareous deposit. In a main stem where the axis is 1·5 mm. in diameter, the central chambered core is 0·45 mm. in diameter, and the cortex about 0·5 mm. thick. The cortex is not loculated (gefächert), but solid throughout. At the proximal end of one of the branches, where the axis is 1·05 mm. in diameter, the core is 0·95 mm. in diameter and the cortex about 0·1 mm. thick. In this region the fibres composing the cortex are more loosely attached and small spaces between them are seen at the periphery.

A transverse section of a branch close to its origin shows that the polyps are connected with twelve large longitudinal canals running close to the axis. The polyps and the longitudinal canals are also connected with a network of smaller canals.

Female gonads 0·2 mm. in diameter were found in one of the specimens, and male gonads 0·2 mm. in diameter in two others. No gonads were observed in two, and six were not examined.

The species *E. robusta* was originally described by Kükenthal (1909, p. 18) from a specimen from Japan in the Vienna Museum.

According to the same author the species described as *E. flabellata* by Broch (1916, p. 42) from N.W. Australia belongs to this species. Thomson and Dean (1931, p. 198) record the species from the east coast of Ceram.

Although three other species of the genus have been described by Nutting from the Malay archipelago and four by various authors from N.W. Australia, *E. robusta* has not previously been recorded from the Barrier Reef or Torres Straits.

The species seems to be distinguished by the prominence of the verrucae, by the large disc-shaped spicules of the coenenchym, by the absence of double clubs or double spindles and its dull grey colour. In appearance it resembles *E. aruensis* (Kükth.), but the verrucae are not prominent in this species, double spindles occur in the coenenchym and the colour is brown (" hellbraun ").

? *Euplexaura robusta*, Kükenthal.

There is a small specimen (x) from the Penguin Channel Station IX which is of some special interest, as it called my attention to the very close relationship of certain species of the Plexaurid genus *Euplexaura* and the Muriceid genus *Discogorgia*.

It consists of a stem 35 mm. high with a disc of attachment (*ca.* 7 mm. in diameter), and a long branch 45 mm. in length arising about 10 mm. from the base.

The diameter of the stem and branch is about 2 mm. The verrucae are scattered all round both stem and branch, are crowded above and separated by small spaces below. They seem to be rather smaller than in the other specimens of *E. robusta*, but the larger ones are almost 1 mm. in height and the same in breadth at the base.

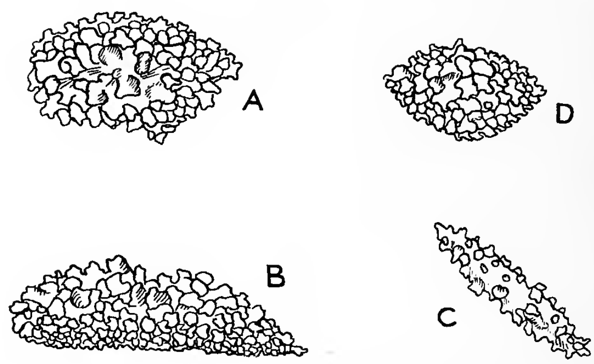
Nearly all of them are tightly contracted.

Examination of the surface shows that the verrucae are protected by overlapping spicules that are spindle-shaped above, and oval or disc-shaped at the base. The surface of the coenenchym is covered with disc-shaped or oval spicules, which also overlap in some places.

Spicules.—There are two distinct layers of the coenenchym—an outer layer bearing thick plano-convex discs or ovals, and an inner layer bearing nothing but spindle-shaped spicules. This inner layer comes to the surface at the top of the verrucae. The spicules agree very closely with those of the other specimens referred to this species.

The discs at the surface are from 0·2–0·25 mm. in diameter, and the larger ovals 0·3–0·45 mm. in length by 0·2 mm. in breadth. There is a complete range from discs, through ovals to thick blunt spindles (Text-fig. 3). The tubercles on the outer convex side of these spicules are longer and thicker than those on the flat side, and in character resemble those of the spicules of the *Placogorgia bebrycoides* of Nutting (1910 (A), pl. xxii, fig. 11).

The inner layer of the coenenchym is thin as compared with that of most of the other specimens in the collection referred to this species. There are not more than two spicules between the axis and the outer layer. These are spindle-shaped, pointed at the extremities, and have a maximum size of about 0·2 × 0·05 mm. The rough tubercles are densely crowded and are not arranged in whorls.



Text-fig. 3.—*Euplexaura robusta.* Specimen x (the "Discogorgia" form). Four spicules of the coenenchym. A, Surface view of a disc. B, Side view of another disc. C, A spindle. D, An intermediate form. × 100 diam.

The operculum in this specimen consists of a crown of two or three rings of spindles with low tubercles about 0·25 mm. in length, and eight points. In many of these points there are only two bent spindles meeting above, which, together with a spindle of the crown, form an acute angle triangle; but in others a third and sometimes a fourth spicule are interposed in the triangle.

Very small male gonads (0·15 mm. diameter) were observed in this specimen.

The colour is the same as that of the other specimens, and all the spicules are colourless.

The specimen agrees so closely with the description of *Placogorgia bebrycoides* by Nutting (1910*a*, p. 83) that at first I referred it to this species, but on further investigation I found that it cannot be separated from *Euplexaura robusta.* The genus *Placogorgia* was founded by Wright and Studer (1889, p. 113) for a species from 80 fathoms in the Atlantic Ocean. Nutting (1910*a*) added ten more species to this genus, but Kükenthal (1919, and 1924, p. 212) separated six of Nutting's species from the Malay Archipelago into a new genus *Discogorgia*, and thus *Placogorgia bebrycoides*, for example, became *D. bebrycoides.* Thomson and Dean accepted this transfer and gave a good figure of the species (1931, pl. xv, fig. 12), which, however, resembles very closely some of our smaller specimens of *Euplexaura robusta* (*cf.* also Kükenthal's figure, 1928, p. 95, fig. 67).

The specimen agrees in so many respects with the original description of *Euplexaura robusta* and with the other specimens of that species from the same locality in the collection that it must be referred to that species.

But it differs from the other specimens in two respects—the greater simplicity of the points of the operculum, and the more slender terminal branches due to a very thin coenenchym. In these respects it seems to agree better with *Discogorgia bebrycoides.* Nutting says that the most prominent feature of the operculum of that species is the three spicules forming an acute-angled triangle. This is, however, a variable character in *Euplexaura robusta.* I have examined a large number of verrucae of this species, and although the larger ones show points of the operculum with two or three pairs of spicules as shown in Kükenthal's figure (1909, p. 19, fig. 13), some of the smaller ones have only one pair, as in *Discogorgia bebrycoides.*

The slenderness of the branches gives the specimen described above a Muriceid appearance. In that respect it resembles Nutting's figure of *Discogorgia bebrycoides*, but as no measurements of the diameter of the terminal branches of this genus have been given, and no statement of the spiculation of the inner layer of coenenchym, it is difficult to determine whether this appearance is of essential importance.

But what are the differences between the Muriceid genus *Discogorgia* and the Plexaurid genus *Euplexaura*? They agree in having a flabelliform ramification; the spicules of the outer layer of the coenenchym are almost identical in size and shape. They both have an operculum of the same type, and the verrucae are of approximately the same size and arrangement.

With these remarkable agreements, and in the absence of any knowledge of the characters of the coenenchym and axis of the type-species of *Discogorgia*, the only conclusion there can be is that this genus is identical with *Euplexaura.* The separation of the two genera in different families is only misleading, and leads to the establishment of many redundant species.

Family Muriceidae.

Muricella perramosa, Ridley.

One small specimen which seems to belong to this species was found on the Linden bank at a depth of 28 fathoms on 24th November, 1928. Linden Bank is off the line of the outer barrier reef about 25 miles E. of Low Isles. The specimen is perfect except that a part of the basal disc has been torn away.

It is 65 mm. high and the branching is almost in one plane, with a spread of about 55 mm. The main stem bears eight branches and some of these subdivide two or three times. The branching is not strictly dichotomous, although in some places it has the appearance of dichotomy. The main stem is 2 mm. and the terminal twigs 1 mm. in diameter. Most of the twigs terminate in swollen extremities about 1·5 mm. in diameter.

The verrucae are low mounds of a maximum height of 0·75 mm. They are not very crowded except on the terminal twigs, where they occur all round the axis without any definite arrangement. On the main stem most of the verrucae are lateral.

The colour is a dark purplish red.

Spicules.—The outer layer of the coenenchym is armed with large red straight or curved spindles. They vary so much that it is difficult to form an estimate of their average size, but many of them are 2·5 mm. in length by about 0·16 mm. in greatest

thickness. Here and there larger spindles may be seen, the largest in my preparations being a little over 3 mm. in length (Text-fig. 5).

Below the surface the coenenchym is crowded with spindles of the same type, only much smaller.

The polyps are all contracted and the details of their armature are not easy to determine accurately, but there are certainly eight groups of flat, spindle-shaped spicules, which are much more definitely arranged " en chevron " than in *M. tenera*. The spicules of the coenenchym agree in form with those described by Ridley for the type. I have examined two preparations of the type spicules, and the largest I can find are only a trifle over 1 mm. in length. The colour of the spicules, also, is a pale orange red as compared with the dark purplish red of those of the Linden Bank specimen.

Although the spicules of our specimen differ from those of the type in these two respects, they agree with the spicules of the specimens of this species collected by the " Siboga " Expedition very closely both as regards size and colour.

The axis of this specimen seems to be purely horn: not the slightest effervescence occurred when a fragment was immersed in strong HCl. In the terminal twigs the axis has a very thin cortex and the core is divided in compartments by thin septa, of which there are about 26 to 1 mm. of length.

In the larger branches the cortex of the axis is much thicker and composed of longitudinal fibres. So far as I could judge from one observation, it is not loculated.

The specimen is a male with gonads 0·2–0·3 mm. in diameter.

The type-specimen of this species described by Ridley (1882, p. 128) is in the British Museum (registered number 82.4.6.1). " It has a broad, fan-like outline," and is 500 mm. high by 175 mm. in extreme breadth. It was found in 90 fathoms of water off the coast of Mauritius.

I have examined spicule preparations and the terminal twigs of the type-specimen, and find that the largest of the spindles of the coenenchym is about 1 × 0·16 mm., in close agreement with Ridley's figures, but the statement that the diameter of the main branches is about 0·18 mm. and of the terminal twigs 0·018 mm. is quite erroneous. The diameter of the main branches of the type-specimen is roughly 5 mm., and of the terminal twigs 1 mm.

The specimen attributed to this species by Wright and Studer (1889, p. 126) was found off Japan in 345 fathoms of water. The largest spindles of this specimen were 1·7 × 0·145 mm.

Nutting's specimens were found in the Kei Archipelago, off New Guinea and other localities in 32–90 metres of water, and the largest spindles are 2·5 mm. in length.

If it be assumed that the identifications of these authors are correct, it is evident that this species has a wide geographical distribution, and a range in depth from 30 metres to 345 fathoms.

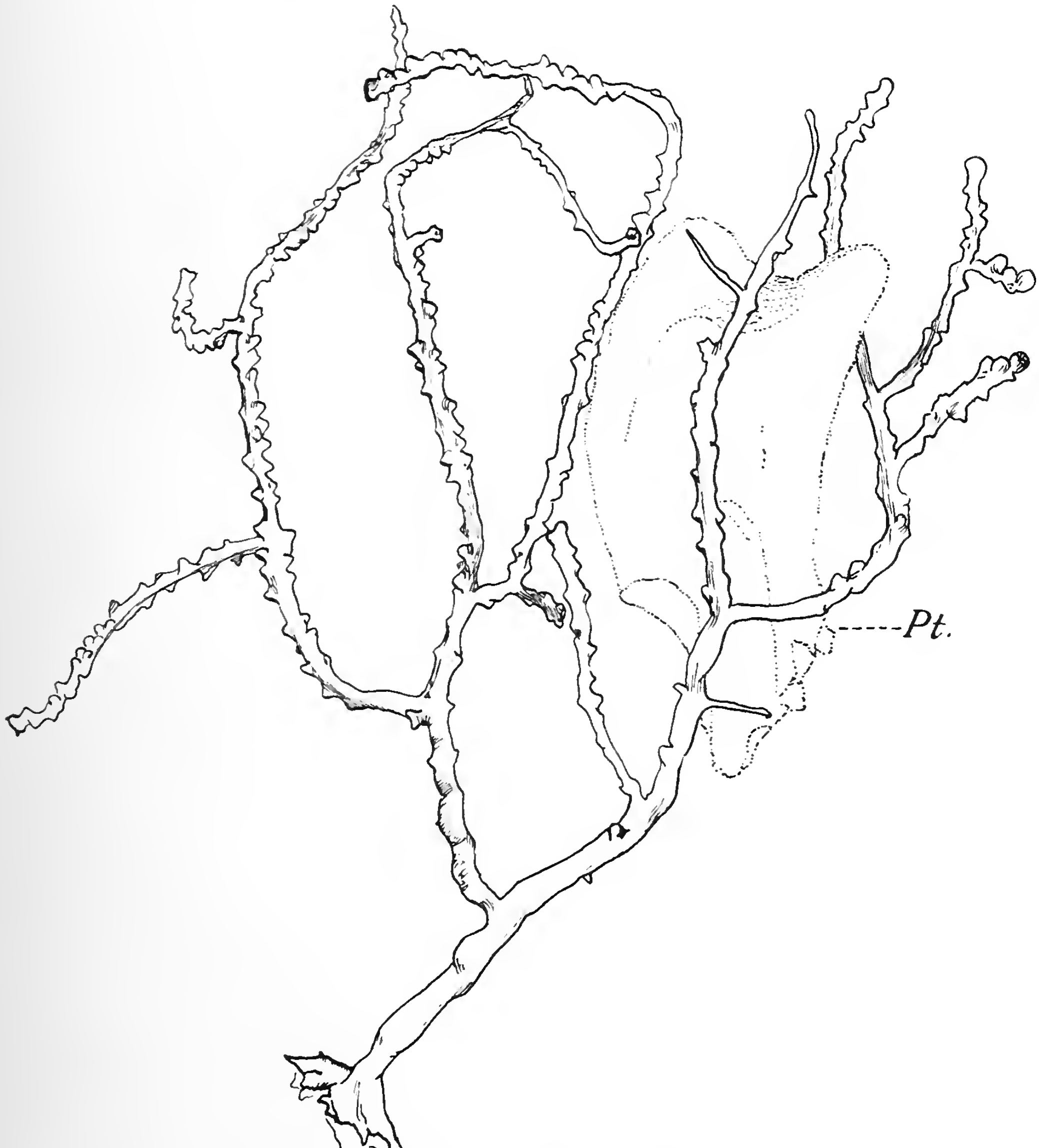
There seems no reason to doubt the validity of these identifications. The only prominent character in which they differ is in the size of the largest spindles of the cortex.

Muricella tenera, Ridley.

There are eight specimens in the collection which may be referred to this species. They were all dredged in the Penguin Channel, five at Station IX (Q) and three at Station XII (E and G).

Every specimen has been carefully examined, and notwithstanding certain differences in minor variable characters I am convinced that they all belong to the same species.

They afford a very interesting study in the variation of ramification and, as some specimens are less contracted than others, the variation in the size and form of the verrucae in the several phases of the contraction of the polyps.



Text-fig. 4.—*Muricella tenera.* Specimen G. A *Pteria marmorata* is attached to a branch of the colony (*Pt.*), and has modified the growth and number of verrucae. Nat. size.

The largest specimen (G) has the general form of a half flabellum (Text-fig. 4). Two branches arise on one side only of the main stem; the lower one subdivides into a number of secondary branches, the upper one is undivided. Above these branches the main stem appears to bifurcate, but both divisions bend over towards the same side as the lower branches. Attached to the colony at the point of bifurcation there is a bivalve (*Pteria marmorata*) 60 × 30 mm. in size, which may have influenced the growth from this point upwards.

This specimen is unfortunately very tightly contracted.

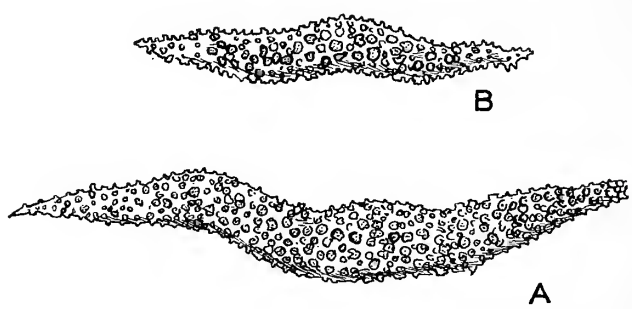
The colony is 130 mm. high and about 80 mm. broad. The disc of attachment is 15 mm. in diameter.

The main stem, consisting of the axis and a very thin covering of coenenchym, is 4 mm. in diameter.

The diameter of a branch taken about the middle of its course is 2·5 mm. and the coenenchym is relatively thick. The terminal branches are up to 60 mm. in length; some have swollen extremities and some have not.

There are no verrucae on the main stem. On the branches they are irregularly distributed, with a tendency in some places to a bilateral arrangement, in others to a spiral arrangement.

In this contracted specimen the verrucae are pointed cones with the aperture closed. They have an average height of about 0·5 mm., none of them exceeding 1·0 mm. high. In some places they are crowded together, in others 2–5 mm. apart. On the stem the very thin coenenchym has only one layer of spicules. In a branch 0·9 mm. in diameter there is an outer layer of large spicules and an inner layer of smaller ones.



Text-fig. 5.—The largest spicule in a group of several hundred taken from the coenenchym of each of the species A, *Muricella perramosa* and B, *Muricella tenera* to indicate their relative sizes. $\times$ 35 diam.

The colour of all the specimens of this species is a dirty grey.

The spicules of the coenenchym are all spindles with a maximum size of about 1·5 $\times$ 0·15 mm. (Text-fig. 5). Some are slightly bent. They are covered with numerous small tubercles, which are not arranged in definite lines or girdles, nor are the tubercles in any spicules appreciably longer on one side than on the other, as they are in so many Muriceidae.

Some of the spicules of the verrucae are a little larger than those of the coenenchym, and most of them extend up from the base to the apex of the cones, but in many of the verrucae smaller spindles are inserted between the larger ones towards the apex.

The arrangement of the spicules of the anthocodiae cannot be easily determined in this contracted specimen, but so far as I can judge from dissections it does not differ from that in specimen Q1, which is described later.

The specimens from Station IX (Q) are not so tightly contracted, and in many cases a part of the body-wall of the anthocodiae and the tentacles protrude from the aperture of the verruca. They are respectively 140, 80, 80, 75 and 60 mm. high. Each one has a small base of attachment and is apparently perfect.

The largest one has five branches arising in one plane right and left of the main stem at

irregular intervals. Another specimen has four branches, which are not in the same plane. The others have only two or three branches which are in the same plane.

The verrucae vary considerably in size. In one specimen they are 2–2·5 mm. high on some of the branches and densely crowded together. On other branches of the same colony they are much smaller and separated by intervals of 2–5 mm. The aperture of many of the verrucae is wide open, showing clearly a well-defined operculum protecting the anthocodiae. The spicules of the verrucae in these cases do not converge as in the contracted ones, but stand up at right angles to the coenenchym, forming a paling round the anthocodia. The spicules of the true calix, forming, in the contracted condition, the operculum, consist of eight triangular groups of spindles ("points"), surrounded by a ring ("crown") of similar spicules. This ring is rarely composed of more than one spicule in thickness, and in some cases consists of only one or two transversely placed spicules altogether.

The spicules of the "points" are very variable in size, but rarely exceed 0·45 mm. in length; the spicules of the "crown" are larger, and in some cases 0·9 mm. in length. They can be distinguished from the coenenchym spicules by their smaller tubercles, but in this respect, as in size, the "crown" spicules are intermediate between those of the operculum and those of the coenenchym.

There are no spicules in the upper part of the body-wall of the anthocodiae, nor in the tentacles.

Two specimens from Station XII (E and E¹) are about 85 mm. high. One of them (E) has a small base of attachment and is apparently perfect. In the other the proximal end of the main stem is broken and covered by an encrusting sponge. It bears three lateral branches, which are apparently quite healthy.

As the verrucae of both specimens are partially expanded, the structure of the operculum as well as other characters can be easily examined, and there can be no doubt that the two specimens belong to the same species. But the differences in external appearances between them are very striking.

In E the branches arise in one plane right and left of the main stem, the verrucae are closely crowded together on the terminal branches, and the larger ones are 1·25 mm. high. The terminal branches are 2 mm. in diameter.

In E^1 the branches are not in one plane; the verrucae even on the terminal branches are situated at intervals of 2·0 mm. or more apart, and are very much smaller than the verrucae of E, the largest being only 1 mm. high. The terminal branches are 1 mm. in diameter.

All the specimens of this species in which gonads were observed were males. Specimen G from Station XII was apparently barren, but specimen E from the same station bore testes from 0·1–0·2 mm. in diameter, and specimen E^1 testes up to 0·45 mm. in diameter. The specimens from Station IX were with one exception males with testes 0·08–0·1 mm. in diameter.

The variations observed in this species may be summarized as follows:

The ramification is usually in one plane, but in two small specimens (*ca.* 85 mm. high) it is not in one plane.

There are great variations in the thickness of the coenenchym. In one specimen, E, the terminal branches between the verrucae are twice as thick as they are in another specimen from the same locality.

The verrucae vary in size according to the state of contraction. In a large contracted specimen they do not exceed 1 mm. high; in a smaller partially expanded specimen they are 2–2·5 mm. high, but they also vary independently in size, as seen in specimens E and E[1].

There is also great variation in the degree of crowding or dispersal of the verrucae.

The characters in which there is agreement are:

1. The ramification of the larger forms is in one plane.
2. The spicules of the coenenchym are spindles provided with numerous scattered tubercles which do not exceed a maximum length of 1·0–1·5 mm. (Hiles, 1899, p. 50, referred a specimen from Funafuti to this species with spicules over 4 mm. in length).
3. There is a well-developed operculum, consisting of eight triangular points and a crown of single spicules.
4. The colour is dull grey and all the spicules are colourless.

The type of this species is in the British Museum. It is a small specimen, and was named *Muricella tenera* by Ridley (1884, p. 335). It was dredged in 14–20 fathoms of water off Port Molle on the coast of Queensland.

A large specimen of the same genus (300 mm. high) found in 49 fathoms in the neighbouring Arafura sea was referred to the new species *M. crassa* by Wright and Studer (1889, p. 131).

Some of the specimens in this collection are intermediate in size between the types of these two species, and as their characters are, in some respects, intermediate between them they link the two species together.

An examination of the type of *M. tenera* shows that they cannot be satisfactorily distinguished from that species, but they afford some evidence that *M. tenera* is identical with *M. crassa*.

The two species agree in having a flabellate form of growth, in colour and in the general form, size and detailed structure of the spicules. The differences are that in *M. tenera* the coenenchym is said to be thin and in *M. crassa* very thick. According to Ridley the spicules of the verrucae are either 1·5 mm. or 0·9 mm. in length in *M. tenera,* and according to Wright and Studer the spicules of the "calix" of *M. crassa* are 0·9 mm. in length.

The vague statement that the coenenchym is very thick in *M. crassa* does not help in the determination of the species. In most of our specimens the coenenchym is very thin on the main stem and the proximal end of the primary branches, becoming gradually thicker towards the terminal ends, where it is relatively very thick. At a distance of about 20 mm. from the distal end in one specimen the axis is 0·9 mm. in diameter and the coenenchym 0·3 mm. in thickness. The difference in size of the coenenchym spicules is not material. The largest spicules in the specimens in the collections are pretty uniformly 1·2 mm.; in the fragment of the type-specimen of *M. tenera* that I examined there are none over 1 mm. in length. It is not quite clear what Wright and Studer meant by the "calix" in their account of *M. crassa.* It is probably not the same thing as the "verruca" of Ridley, but the group of spicules at the base of the anthocodia forming the true calix or operculum. Ridley gives the size of the spicules of the "polype" of *M. tenera* as about 0·35 mm. in length, but there is no good account of the constitution of the operculum in this species.

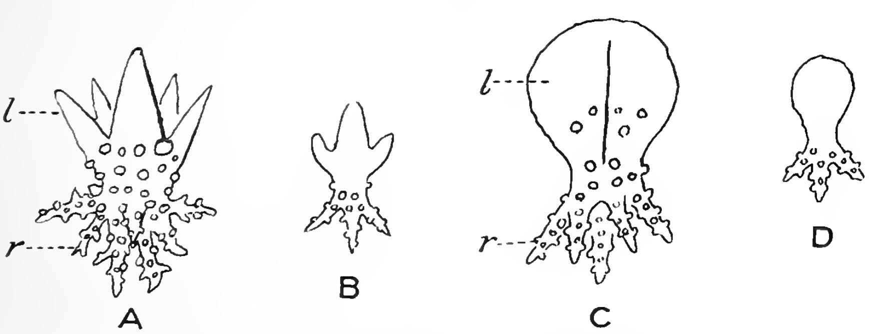
In our specimens the spicules of the triangular groups ("points") of the operculum

are very variable in size and rarely exceed 0·4 mm. in length. The spicules of the surrounding ring " crown " are larger, and in some cases are 0·9 mm. in length.

The identity of *M. crassa* and *M. tenera*, however, cannot be firmly established, as the type-specimen of the former was not returned to the British Museum with the rest of the " Challenger " Collection, and it is not known where it has been deposited.

Genus *Echinogorgia*, Kölliker.

This genus was founded by Kölliker in 1865 (p. 136) for certain species formerly referred to *Gorgonia* by Esper. His definition of the genus simply stated that the species has a horny axis with small superficial spiny spicules of a peculiar form, and small or slightly developed calices. These peculiar spicules received different names. The forms with a single flat leaf as in *E. sasappo* he called " Schuppenkeulen " ; the forms with triangular leaves, as in *E. furfuracea*, he called " Stachelkeulen " (Text-fig. 6). The name " Blattkeulen " in this paper was confined to the spicules of certain species of *Eunicea*.



TEXT-FIG. 6.—Diagrams to illustrate the structure of the Blattkeulen. A, The variety called " Stachelkeule " by Kölliker. B, Small form of the same variety. C, The variety called " Schuppenkeule " by Kölliker. D, Small form of the same variety. *l*, the leaves ; *r*, the roots. In C the single leaf has a median keel and bears some tubercles.

Kükenthal (1919, p. 5) defined the " Blattkeulen " thus : " Die Stacheln der Anschwellung verbreitern sich blattförmig ; bei plattenartiger Ausbreitung einzelner Blätter entstehen sie Schuppenkeulen."

In recent times the term " Blattkeulen " has been used in a more general way for the spicules belonging to several genera in which leaf-like processes project from the surface of the coenenchym and verrucae, and are supported by root-like processes which penetrate into the mesogloea. Kükenthal himself, in 1924, calls the spicules of *Echinogorgia sasappo* and *Plexauroides praelonga* " Blattkeulen," which, according to Kölliker's definition, are typical " Schuppenkeulen."

Several authors writing in the English language have called these spicules " foliaceous clubs." In my opinion it is better to retain Kölliker's original name " Blattkeulen," but to use it in a more general sense.

In many of the species of the genus large tuberculated spindles are also found, usually situated in the coenenchym close to the axis. In *E. sphaerophora* some of these spicules occur at the surface and can be seen without dissection in dry or preserved specimens. They vary from 0·5–1·0 mm. or more in length. In *E. furfuracea* there are no spindles as large as this.

In some species a few large spicules may be found which seem to be a combination of these two types, *i. e.* a spindle- or half-spindle-shaped base with foliaceous expansions at one end or on one side. Such a spicule is figured by Kölliker (1865, pl. xviii, fig. 9, 1) for *E. sasappo* and is termed a " halbseitige Blattkeule " (Text-fig. 8). These spicules, which may be formed by a fusion of two or more scleroblasts in development, are not common in any of my preparations, and in some cases I have found only one on searching through a heap of several hundred dried spicules.

It would not be wise to use the presence or absence of these spicules as a guide for the determination of species.

A third type of spicule is very common in preparations of the spicules of the species of this genus. It consists of a short, smooth, median bar, terminating in a knob at each end. They are always very much smaller than spicules of the other two types. They have received various names according to the size and arrangement of the tubercles on the knobs, *e. g.* dumbbells, capstans, double wheels, double stars, etc. (Text-fig. 10).

Woodland (1905, p. 300) described a form of this type in the development of the spicule of *Alcyonium* under the name " caudal vertebra."

In this report I have used Sir Arthur Thomson's word " capstans " throughout for spicules of this type.

There can be little doubt that these spicules in this genus are stages in the development of spicules of the other types. It may be that in some cases they are arrested in development and never get beyond the " capstan " stage, but there is no evidence to prove or to disprove it.

The relative number of these spicules in preparations is not constant. In the case of two species (*E. furfuracea* and *E. reticulata*) I found a great many more " capstans " in the larger specimen than in the smaller one. In the species referred to *Plexauroides* I found no " capstans " in my first preparations, but on searching through a heap of dried spicules a few typical capstans in three out of six specimens.

The only conclusion that can be drawn from these observations is that the presence or absence of "capstans" cannot be safely used for the determination of specific characters.

The method adopted in this report for the determination of the species of this genus is to take Esper's description and figures of the species referred by Kölliker to the genus *Echinogorgia,* and the figures given by Kölliker of the spicules of the original types in the Erlanger Museum, which he investigated. The specimens in the collection which agreed in ramification and colour with Esper's plates and in the general character of the spicules with Kölliker's figures were referred to Esper's species. In this way four out of the five species were identified. One species (*E. sphaerophora*) was quite distinct from the others in having large spindle-shaped spicules at the surface of the coenenchym, and this has been referred with some hesitation, as the only specimen is a very small one, to the species proposed by Kükenthal.

Of the five species in the collection, *E. sasappo* is distinguished from the others by having " Blattkeulen " of the variety known as " Schuppenkeulen." The others have typical Blattkeulen. *E. sphaerophora* is distinguished from the others by having large spindles at the surface of the coenenchym.

E. furfuracea and *E. reticulata* have, when full grown, profuse ramification in one plane with anastomosing branches.

E. furfuracea has colourless spicules and no large spindle-shaped spicules in the coenenchym.

E. reticulata has red spicules and many large spindles in the coenenchym.

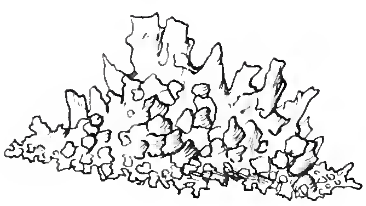
E. umbratica has a loose flabelliform ramification without anastomoses and colourless spicules.

Echinogorgia sasappo, Esper.

There are two specimens dredged in Penguin Channel (Station XII).

The larger of these (specimen L) consists of a main stem, without a base of attachment, 100 mm. high. From this stem spring three branches, not in the same plane, at intervals of about 30 mm. The longest of these branches is 25 mm. The stem and branches are about 2·5 mm. in diameter.

TEXT-FIG. 7.



TEXT-FIG. 8.

TEXT-FIG. 7.—*Echinogorgia sasappo*. One of the larger Blattkeulen without a keel on the leaf.
TEXT-FIG. 8.—*Echinogorgia sasappo*. One of the spicules called "halbseitige Blattkeulen" by Kölliker.

The verrucae are prominent, some dome-shaped, others, more fully expanded, conical. The height of the conical verrucae is 0·75 mm. They are densely crowded on all sides of the stem and branches, but are smaller and more scattered on the lower third of the stem.

The colour is salmon-red.

SPICULES.—The surface of the coenenchym and verrucae is protected by a layer of "Blattkeulen" of the variety "Schuppenkeulen," the leaves of which project irregularly on the coenenchym, but overlap like imbricated scales on the verrucae. These spicules are extremely variegated in form and size, but the maximum size appears to be about 0·3 mm. in length.

The smaller forms, 0·18 mm. in length, consist of a single smooth leaf and three tuberculated rootlets (Text-fig. 6, D).

In the largest forms there is a single leaf with a crenated edge and a single keel, or in addition to the keel two or four lateral ridges, in which case the keel and ridges project from the edge of the leaf, giving it a palmate outline; and in the more complicated forms the keel and ridges are expanded vertically to form secondary plates at right angles to the leaf. There are some "Blattkeulen," however, without keels on the plates (Text-fig. 7).

All the Blattkeulen are pale pink in colour.

There are no spindle-shaped spicules at the surface of the coenenchym, but lying close to the axis and parallel with it there are some large profusely tuberculated spindles reaching a size of 0·75 mm. × 0·15 mm. In addition to the typical spindles there is a great variety of irregular shaped spicules, bearing, in many cases, triangular tubercles on one side only. The largest of these are of the type called by Kölliker "halbseitige Blattkeulen" (Text-fig. 8). Most of these spicules are colourless, but a few have a faint pink colour.

There are some pink capstans in my preparations 0·1 mm. in length.

A few of the polyps of this specimen are partially expanded. There is a thick collar of spicules below the tentacles, composed of straight or slightly bent spindles with small pointed tubercles, and a few forked spicules. The largest spindles in one of these anthocodiae are about 0·2 × 0·03 mm., but there are longer spindles of this type in the spicule preparations. There are no spicules in the tentacles nor, apparently, at the base of the anthocodia.

There is some calcareous matter in the axis.

The specimen is a male with gonads 0·3 mm. in diameter.

The smaller specimen (Dd) consists of a stem 55 mm. high, attached to a worm tube by a small circular disc 7 mm. in diameter. A small broken branch arises at right angles to the stem 38 mm. from the base. The diameter of the stem is 1·5 mm.

The characters of the verrucae and the colour agree with those of the larger specimen.

Spicules.—The "Blattkeulen" which cover the surface of the verrucae and coenenchym differ from those of the larger specimen in a more general simplicity of form. The smaller ones, 0·2 mm. in length, have a single smooth leaf with two or three rootlets. The larger ones have two or three tubercles on the upper side of the leaf, but no keel; the largest, 0·3 mm. in length, occasionally show a median keel, but never lateral ridges, and in only a few forms is the leaf lobed or divided.

There are some pink tuberculated spindles in the coenenchym, of which the largest I have measured is 0·5 × 0·16 mm.

There are some capstans (0·1 mm.), and numerous small (0·1–0·2 mm.), very irregular spicules, crosses, rods, etc., which may be younger stages of the other types.

From the examination of two partially expanded polyps it seems certain that the spiculation of the anthocodiae is similar to that of the larger specimen.

The specimen is a male, with gonads 0·3 mm. in diameter.

The differences observed between the spicules of these two specimens might be regarded as of sufficient importance to separate them into two distinct species.

I am convinced, however, that these differences are correlated with the size or age of the two specimens. In both specimens numerous small "Blattkeulen" (about 0·18 mm.) can be found which are identical in shape; between these and the elaborate "Blattkeulen," with 3- or 5-fid leaves armed with prominent keels, there are many intermediate stages in both specimens, but in specimen L the later stages are dominant, in specimen Dd the earlier stages are dominant.

The spindles of the cortex, which are mainly colourless in L, but coloured in Dd, offer another point of difference which may be correlated with the size of the branches. These spicules are found only in the lower layer of the cortex, and if the development of the colour is determined by light, the specimen with the thinner cortex and less elaborate

" Blattkeulen," which would be more penetrable by light, would be more likely to have coloured spindles.

The illustration of *Gorgonia sasappo* given by Esper (1797, pl. ix) shows a number of red gorgonians, each with a few branches as in our larger specimen. The coenenchym is rather thick, and the low verrucae are densely crowded all round the branches.

Kölliker (1865, pl. xviii, fig. 9) gives three figures of the spicules of *Echinogorgia sasappo*; one of these (No. 3) with a single leaf and a complex root is similar to many spicules of the larger specimen L, but does not show the prominent keels which most of the " Blattkeulen " of this specimen possess. I have found a few spicules in my preparations corresponding with Kölliker's (No. 1) of a " halbseitige Blattkeule " and there are several spicules in the smaller specimen similar to his (No. 2) of a " Warzenkeule."

The spicules of *E. mertoni* (Kükenthal, 1919, p. 282) are similar to those of our smaller specimen, but the colour of this species is grey.

The species described by Nutting (1910, p. 66) as *E. flora* agrees with our specimens in the lax ramification, and the only type of " Blattkeule " that is shown in his pl. xxi, fig. 10, is similar to many that occur in my preparations. The colour of *E. flora*, however, is " very light brown and the spicules colourless." This species, however, is also closely related to *Plexauroides praelonga* (see p. 498, *infra*).

The name *Gorgonia sasappo* was given by Pallas to a species which he identified with the Accarbaar Sasappo of Rumphius (' Herbarium Amboinense,' vol. vi, p. 223, t. 83). A comparison of the figure given by Rumphius with the figure given by Esper of *Gorgonia sasappo* suggests very strongly that the gorgonian called by the Malays Accarbaar Sasappo is not identical with Esper's species.

However, if the specific name stands, as it should do, it should be spelt as Rumphius spelt it, and not in the form sassapo, as used by Kükenthal and other writers.

Echinogorgia furfuracea, Esper.

There is one large specimen (B) belonging to this species and a small one (P) which may be a juvenile form of the same species. They were both dredged in the Penguin Channel, the former at Station XII and the latter at Station IX.

The larger specimen (B) is definitely flabellate in form and the branches anastomose in several places. The frond, as it is preserved—the base is missing—is 200 mm. high and 150 mm. broad—the largest specimen in the collection.

The stem divides close to its origin and is lost in the general ramification. There is no pronounced midrib.

The main branches are almost uniformly 3 mm. in diameter. The terminal branches are very short and slightly swollen at the extremity.

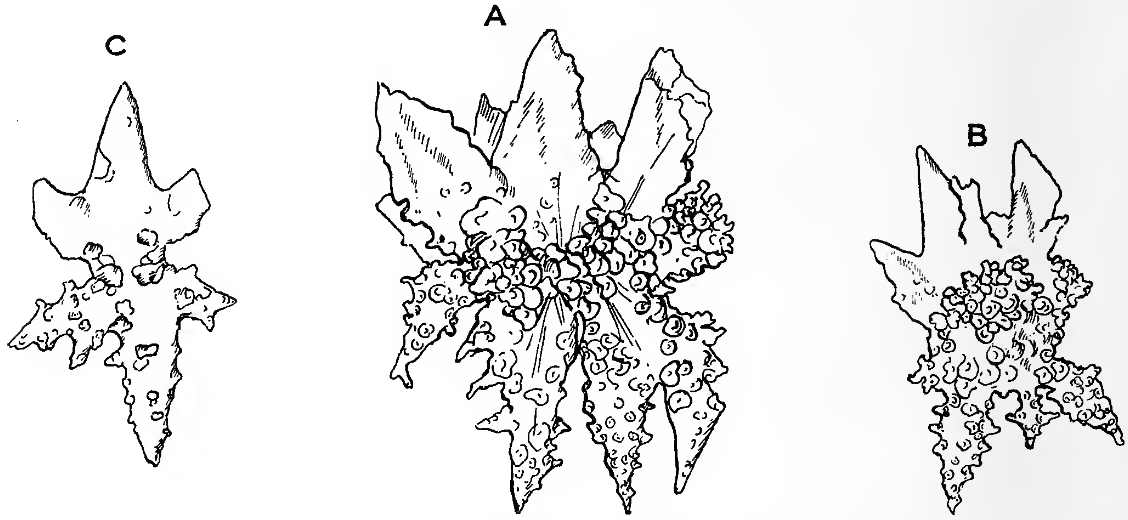
The verrucae are low mounds about 1 mm. in diameter at the base. They are irregularly distributed, and rather crowded on the terminal and secondary branches.

The colour of the specimen in spirit is dark grey, almost black on the older branches, but there is a note on the label—" yellow in colour."

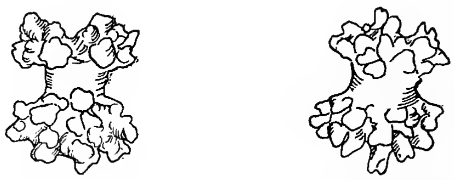
SPICULES.—The " Blattkeulen " cover the coenenchym and verrucae. When full grown they are a little over 0·3 mm. in length and 0·3 mm. in breadth. They exhibit three to eight or more triangular leaves and have three to four tuberculate roots

(Text-fig. 9). The arrangement of the leaves is very variable. In some cases they have a roughly radial arrangement; in others the outer leaves are arranged in an irregular circle round a group of three or four central leaves. In many others there is a very prominent central leaf with an irregular group of smaller leaves around it.

The leaves are usually smooth and triangular in section, but some of them bear a few scattered tubercles. The smallest "Blattkeulen," 0·2 mm. in length, have three pointed leaves in a row and usually three short roots (Text-fig. 9, C).



TEXT-FIG. 9.—*Echinogorgia furfuracea.* A and B, Two forms of the larger Blattkeulen. × 200 diam. C, A smaller form. × 300 diam.



TEXT-FIG. 10.—*Echinogorgia furfuracea.* Two examples of the "capstan" spicules. × 300 diam.

There are numerous small "capstans" and stellate spicules (*ca.* 0·06 mm. in length) in the coenenchym (Text-fig. 10).

An important feature in the spiculation of this specimen is the absence of any very large spindle-shaped spicules in the coenenchym. A few straight tuberculated spindles occur in the older branches, but the largest of these is not more than 0·3 mm. in length.

The polyps are so tightly contracted in the specimen that the spiculation of the anthocodiae cannot be very satisfactorily determined, but the spicules which form the operculum have the usual form of slender straight or bent spindles with low tubercles and about 0·3 mm. in maximum length.

All the spicules are quite colourless.

The axis at the base is 3 mm. in diameter, and consists of an excentric core about 0·2 mm. in diameter, bearing crowded crystals of calcium carbonate, and a very thick dense cortex without a trace of loculi.

The axis of the terminal branches is similar to that of the other species, with its chambered core and a cortex of loosely bound horny fibres.

The specimen is male, with gonads 0·2 mm. in maximum diameter.

The small specimen, P, is 50 mm. high × 30 mm. broad. It is flabellate in form, and divides into twelve terminal branches without anastomoses. It springs from a disc-shaped base of attachment about 8 mm. in diameter.

The verrucae are a little smaller than in the larger specimen, but in form and distribution they agree with the verrucae of the larger specimen.

The colour is dark grey.

SPICULES.—The "Blattkeulen" are similar to those of B, but smaller and simpler in form. The largest in my preparation is 0·24 mm. in length and has four leaves and three roots.

The smaller forms have three leaves in a row and three roots.

There are a few small capstans and, in my preparation, one tuberculated spindle 0·4 × 0·07 mm.

No gonads were observed in this specimen.

The illustration given by Esper (1797, pl. xli) of *Gorgonia furfuracea* agrees very closely in form and colour with the larger specimen (B) in this collection.

The spicules figured by Kölliker (1865, pl. xviii, fig. 18) are similar to many of the spicules in my preparations, although the "Blattkeulen" as drawn by him are smaller (0·2 mm.).

Kükenthal (1924, p. 201) says that in this species the walls of the verrucae bear peculiar "Blattkeulen," in which the leaves form a collar round a narrow central space.

There are no spicules answering to this description in the verrucae of either of our specimens, and there is no such spicule in Kölliker's illustration of Esper's type-specimen.

Kükenthal's description of the species was based on an investigation of the specimen referred to this species by Studer (1878, p. 652) from W. Australia.

Nutting (1910*a*, p. 63) described a specimen from the Flores Sea under the name *E. furfuracea* with "Blattkeulen" on the verrucae, bearing leaves similar in arrangement to that described by Kükenthal and others, in which the leaves are heavily keeled. In Kölliker's drawings of the type the leaves of the "Blattkeulen" are not keeled. The "Siboga" specimen also differs from the type in colour, being light pinkish brown.

The specimens described as *Echinogorgia furfuracea* by Studer and Nutting seem to differ in some important respects from the two specimens described under the same name in this paper and from Esper's type-specimen.

There can be no doubt that the specimens described by Ridley (1884, p. 337) from Port Denison and Port Curtis on the coast of Queensland as *Echinogorgia flabellum* belong to the same species as those referred in this report to the species *E. furfuracea*. I have examined the specimens* and preparations of their spicules in the British Museum, and find them in almost complete agreement with the specimens from the Penguin Channel.

There is no evidence, however, that Esper's *Antipathes flabellum* was an *Echinogorgia*. Only the bare axis is shown in the illustration, and this is more suggestive of a *Plexaurid* than of a Muriceid. Kölliker does not give any notes on this type. The species should therefore disappear from our lists and Ridley's specimens referred to *E. furfuracea*.

* There are two or three specimens on the sheet with the same name, which may not belong to this species. The specimens referred to here are registered as follows: 81.10.21.165 and 177.

Echinogorgia sphaerophora, Kükenthal.

There is a very small specimen in the collection from the Penguin Channel (Station IX) which, with some hesitation, may be referred to this species.

It consists of a single stem 55 mm. high, with two short branches and a rudimentary one, attached to a stone by a circular disc of attachment 5 mm. in diameter. The stem and branches are not more than 1 mm. in diameter.

The verrucae are crowded on all sides, rather prominent and almost hemispherical in shape.

The colour is pale red.

Spicules.—The "Blattkeulen" are very irregular in form, but, as in the type-specimen, they are smaller (0·2 mm.) than in most of the species of the genus.

In many there is a single trifid leaf, in some cases with a definite keel, in others densely tuberculated at the base. In other "Blattkeulen" there are several pointed leaves quite irregularly arranged. They bear three or four thick, short, and densely tuberculated rootlets. The smallest "Blattkeulen" have three pointed leaves in a row and three or four short thick tuberculated roots.

These spicules are all colourless.

The most characteristic feature of the species, however, is the presence of large spindle-shaped spicules at the surface of the coenenchym. They are pink in colour and from 0·6 to 0·9 mm. in length.

The larger ones are plano-convex in optical section and are densely covered with large tubercles, those on the outer convex surface being the most prominent.

There are a few small "capstans," but owing to the very small size of the specimen only one preparation of spicules has been examined.

The verrucae are fortunately not very tightly contracted, and the operculum can be clearly seen. It agrees very closely with Kükenthal's description and figure of the type-specimen (1919, p. 287).

Gonads were not observed in this specimen.

The original description by Kükenthal (1919, p. 286) of this species was based on the examination of two specimens in the Münich Museum with the rather vague locality "Ostindien." The two specimens were respectively 195 mm. and 87 mm. high, and therefore much larger than the specimen from the Penguin Channel.

The smaller of the two original specimens differs in some respects from the larger one, and Kükenthal had some hesitation in placing it in the same species.

Both specimens, however, form fan-shaped colonies, with some anastomoses of the branches and a similar armature of the polyps.

The large spindle-shaped spicules of the cortex are, however, very much larger (0·5 mm.) in the smaller specimen than in the larger. In the very small Penguin Channel specimen they are apparently larger still (0·9 mm.). Neither of the type-specimens had a red colour; they were both "hellgrau."

The very large spindle-shaped spicules call to mind the large spicules of *E. macrospiculata* (Thomson and Simpson, 1909, p. 219), but in this species they are not stated to be at the surface of the coenenchym as in *E. sphaerophora*, and in other respects the two species are not in agreement.

Echinogorgia reticulata, Esper.

There are two specimens in the collection from the Penguin Channel belonging to this species. one (H) from Station XII and the other (F) from Station IX.

Specimen H consists of a main stem arising from a spreading base of attachment 20 mm. in diameter. giving off branches sparsely in approximately the same plane to form a loose flabellum. It is 100 mm. high × 70 mm. broad. There are no anastomoses.

The branches are comparatively slender—*ca.* 2 mm. in diameter. The main stem at the base is 3 mm. in diameter.

The verrucae are rather more prominent than in the specimens of *E. furfuracea*, densely crowded and without any definite arrangement.

The colour of the colony is a dark purplish red.

SPICULES.—The larger "Blattkeulen" are about 0·36 mm. in length × 0·3 mm. in breadth. Their leaves are triangular in shape and the root bears three or four pronounced rootlets. At the margin of the calix the "Blattkeulen" usually bear five pointed leaves in a row, the middle leaf being very prominent.

The leaves of these spicules in the coenenchym bear numerous blunt tubercles and in others the margin is dentated.

There seems to be no definite arrangement of the leaves. In many there is a prominent leaf in the centre, surrounded by a circlet of smaller leaves, but in the large ones there is no regular arrangement. Some of the larger spicules have a blunt, tuberculated keel.

All these spicules are pink in colour.

There are very few capstans in this specimen. They have a very faint pink colour.

There are numerous profusely tuberculated pink spindles in the coenenchym, varying in size to a maximum of 0·9 × 0·13 mm., but none of these are visible at the surface.

The spicules of the anthocodiae are bent spindles, *ca.* 0·3 mm. in length, with a maximum thickness of 0·03 mm. They are thicker than the corresponding spicules of *E. furfuracea*. In the retracted verrucae they form an operculum. These spicules are colourless.

This specimen is a female with ova up to 0·1 mm. in diameter.

Specimen F is also fan-shaped in growth, but differs from H in the presence of several anastomoses. It is 160 mm. high × 70 mm. broad, and springs from a spreading base 40 mm. in expanse.

The branches are more slender than in H, most of them being not more than 1 mm. in diameter.

The main stem is soon lost in the general ramification; the axis, which is bare near the base, is 2 mm. in diameter.

The verrucae are similar to those of specimen H, and the shade of red colour is almost the same.

SPICULES.—The "Blattkeulen" of F and H are alike, but there is a difference between the two specimens in the relative numbers of the "Blattkeulen" and the spindles.

In an ordinary slide preparation of the spicules of F the number of spindles (up to 0·9 mm. in length) is about equal to the number of "Blattkeulen"; in H the "Blattkeulen" greatly exceed the spindles in number.

Moreover, in F there are many more capstans than in H, where they are very scarce. They are from 0·06–0·07 mm. in length.

This specimen is also female, the eggs being rather more advanced than in H. One egg was 0·3 mm. in diameter, but the largest eggs in most of the polyp cavities were only 0·2 mm. in diameter.

The general appearance of these specimens agrees fairly well with Esper's pl. IXA of *Gorgonia sasappo* var. *reticulata*, although the branches seem to be more slender. Kölliker (1872, pl. xviii, fig. 10) gives an illustration of a large red, irregular spindle of *Echinogorgia pseudosassapo* 0·9 mm. in length, which is an abnormal form of the large red spicule of our specimens. The name of the species was changed to *E. reticulata* by Kükenthal (1924, p. 202).

Our specimens agree with Kükenthal's definition of the species except in one particular. The branches and twigs are not greatly flattened. In one colony described by Nutting from the Malay Archipelago (1910A, p. 64) the branches are said to be flattened, but this is not mentioned as a character of the species either by Wright and Studer (1889, p. 119) in their specimen from Torres Straits, or by Thomson and Dean (1931, p. 205) in a specimen from N. New Guinea.

Echinogorgia umbratica, Esper.

The specimen was obtained in Penguin Channel (Station IX).

It is in the form of a loose flabellum without any anastomoses, 90 mm. high by 70 mm. broad.

A thick stem, 5 mm. in diameter, rises from a thin band of attachment, 9 mm. in length, to any oyster shell.

The branches arise laterally from the main stem, which does not bifurcate, but can be traced right through the colony to the margin of the flabellum. The branches are from 2–3 mm. in diameter and end in slightly swollen knobs. The verrucae are small (1 mm. in diameter), close set and distributed all round the stem and branches. An unusual feature of this specimen is that the verrucae extend the whole way down the stem and there are a few verrucae on the base itself.

The colour is a light brown.

SPICULES.—The " Blattkeulen " are very similar in shape to those of *E. furfuracea*, but on the whole rather smaller in size. The larger " Blattkeulen " of *E. furfuracea* are a little over 0·3 mm. long; those of this specimen are a little less than 0·3 mm.

When fully developed they have four or five thick, pointed leaves, which very rarely show any trace of a keel, and four or five heavily tuberculated rootlets.

The smaller " Blattkeulen " (0·2 mm.) have usually three small triangular leaves and three rootlets.

There are several capstans (0·1 mm.) in the preparations.

There are more spindle-shaped spicules in the coenenchym in this specimen than in the specimens of *E. furfuracea*. An exceptionally large one is 0·75 × 0·15 mm., but most of them do not exceed 0·6 × 0·12 mm. in size.

All the spicules are colourless.

There are no gonads in this specimen.

The general form and colour of this specimen resemble the illustration given by

Esper, pl. xx, of *Gorgonia umbratica*, and the spicules agree in form with the figures given by Kölliker (1865, pl. xviii, fig. 495) of *Echinogorgia umbratica*. It is noteworthy that the "Blattkeulen" of this species are much smaller (0·11 mm.) than those of *E. furfuracea* (0·22 mm.) according to Kölliker's measurements.

Echinogorgia umbratica is included in Kükenthal's (1924, p. 204) "uncertain species," and no specimens have been referred to it since the publication of Kölliker's memoir.

This specimen from the Penguin Channel has several characters in common with those of *E. furfuracea* from the same locality (p. 487), and it is possible that it is only a variety of this species. The principal points of difference are that (1) the ramification is less profuse and there are no anastomoses, (2) the "Blattkeulen" are smaller, and (3) the number of large spindle spicules in the coenenchym is greater.

The specimen is much smaller than the larger specimen of *E. furfuracea* in the collection, and it occurred to me that the smaller "Blattkeulen" might be correlated with size, but a careful examination of the "Blattkeulen" of the smaller specimen of *E. furfuracea*, which is not so large as that of *E. umbratica*, has shown that they are approximately as large as those of the larger specimen of *E. furfuracea*.

As regards the size and number of spindle-shaped spicules in the coenenchym, the smaller specimen of *E. furfuracea* is intermediate between the two species. They are more numerous and some of them larger than in the older specimen of that species, but not so numerous, and apparently do not reach the same size as in this specimen of *E. umbratica*.

These statements are based on the examination of a large number of dried spicules from branches of approximately the same size. It is possible that if the investigation had been carried further, so as to include many different parts of each colony (*i. e.* base, stem, terminal twigs, etc.) they might have to be modified.

Genus *Plexauroides*.

No one who has had experience of systematic work in the Gorgonacea can doubt that the genera *Plexauroides* and *Echinogorgia* have many very similar features, and are difficult to distinguish from one another. But according to modern classifications, *Plexauroides* belongs to the family Plexauridae and *Echinogorgia* to the Muriceidae.

In 1884 (p. 338) Ridley said "*Echinogorgia* of Kölliker is nearly allied to *Plexaura*," but since his paper was published the species he described under the name *Plexaura praelonga* has been transferred to the genus *Plexauroides*. With even greater emphasis it may now be said that *Echinogorgia* is nearly related to *Plexauroides*.

If we consider the characters of the Plexauridae and Muriceidae given by Kükenthal (1924), there is found to be no sound reason for placing the two genera in separate families. According to his key plan of the families the Muriceidae have polyps with an operculum (Deckel); in the Plexauridae the polyps have no such operculum. In the more detailed definitions of the families (pp. 89 and 139) the polyps of the Plexauridae are said to be completely retractile or retractile into calices or apparent calices (Scheinkelche). In the Muriceidae the calices are usually higher than they are broad.

In the coenenchym of the Plexauridae there are two layers bearing different kinds of spicules, but no statement is made on this point in the definition of the Muriceidae. There is no clear distinction made between the axes of the two families.

The only clearly defined characters, therefore, which separate the families according to these distinctions is the presence or absence of an operculum or cover to the retracted polyps.

If we compare the definitions of the two genera, *Plexauroides* and *Echinogorgia*, (pp. 124, 198) the differences between are also very slight.

Both genera form fan-shaped colonies, but the branches anastomose in *Echinogorgia* but do not anastomose in *Plexauroides*. The calices, *i. e.* the verrucae, are pronounced in *Echinogorgia*, feebly developed in *Plexauroides*. In both genera the inner layer of the coenenchym bears spindles which are said to be small in *Plexauroides*. In *Echinogorgia* no mention is made of the size of the spindles, but they are said to be accompanied by crosses and other forms.

In the definition of *Echinogorgia* (p. 198), however, the important statements are made that the axis has the typical structure of the Plexauridae and that there are longitudinal canals arranged round the axis.

It may be seen that according to these definitions the two genera are alike in forming fan-shaped colonies, in showing two layers of the coenenchym, of which the outer layer bears "Blattkeulen," and, in some cases at least, the inner layer has longitudinal canals grouped round the axis. The structure of the axis itself is the same in the two genera.

The supposed difference between them as regards the presence or absence of an operculum is found on analysis to be of very uncertain value.

It may be said that Kükenthal (1924) did not make any clear distinction between his terms "Deckel" and "Operculum." They appear to be synonymous.

In the typical species of *Echinogorgia* the retracted polyps are covered and protected by an outer ring of spindle-shaped spicules (the crown), and eight triangular groups of bent spindles meeting by their apices in the centre (the points).

It is true that in *Plexauroides rigida* there are no spicules in the polyps and therefore no operculum, but in *Plexauroides praelonga* and *P. simplex* (Kükenthal, 1910, p. 95, fig. xlix) this armature of spicules shows no difference from that of a typical species of *Echinogorgia*. The verrucae of *Echinogorgia* are usually more pronounced than in *Plexauroides*; but low mound-like verrucae, not to be distinguished from the verrucae of some species of *Echinogorgia*, occur in *P. simplex* (Kükenthal, 1910, pl. i, fig. 3) and in other species of the same genus.

There is also a very well-defined operculum in species of *Euplexaura* (see p. 472).

The axis of these specimens affords no support for the separation of the genera in different families. The axis of every specimen in this collection of both genera has been examined and I can find no distinction of any importance between them.

Nutting (1910*a*, p. 67), in his description of *Echinogorgia flora*, says: "Were it not for the fact that the axis cylinder is devoid of calcareous matter the writer would be much tempted to place this species in the genus *Plexaurella* of the family Plexauridae." This species seems to be identical with Ridley's *Plexauroides praelonga* var. *typica*.

The axis of the smaller specimens and of the branches of the larger ones in both genera is free from calcareous inclusions, but in the stem or larger branches of *E. sasappo*, *E. furfuracea* as well as *Plexauroides rigida* and *P. prœlonga* there is sufficient calcareous matter in the axis to give a distinct reaction with an acid.

The genus *Paraplexaura* (Kükth.) is evidently closely related to *Plexauroides* and to *Echinogorgia*. In discussing its relationship Kükenthal (1919, p. 252) says it is

closely related to *Plexauroides*, and differs only from *Echinogorgia* in the absence of an operculum.

The separation of these two genera into different families is obviously very inconvenient and has no scientific foundation. It has probably led to many mistakes in the past and, if retained, will lead to more in the future.

The occurrence in *Plexauroides* of spicules of the type of "Blattkeulen" seems to indicate that the affinities of the genus are closer with the Muriceidae than with the Plexauridae, and the general resemblances as regards the characters of the axis, the canal system and indeed the operculum (when present) of the species of *Plexauroides* and *Echinogorgia* support this conclusion.

For these reasons the genus *Plexauroides* is transferred to the family Muriceidae in this Report.

It is still an open question whether the species of *Plexauroides* should not also be transferred to the genus *Echinogorgia*. If the former generic name is retained there is only one very unsatisfactory character to distinguish the genus from *Echinogorgia*, namely, that the coenenchym is relatively thick and smooth.

In *Echinogorgia* the verrucae are prominent; in fully contracted specimens of *Plexauroides* the verrucae are almost flush with the general surface of the coenenchym. It is this character which gives the species of the latter genus a superficial appearance similar to that of many of the Plexauridae.

Plexauroides rigida, Kükenthal.

The specimen described below (R) was dredged in Penguin Channel (Station XII). It is 180 mm. high, and gives off dichotomously four branches about 30 mm. in length. The diameter of the main stem and branches is approximately 4 mm. The branches are not in the same plane and there are no anastomoses. In a branch 4 mm. in diameter the axis is 1 mm. in diameter.

The surface is covered with verrucae, showing no definite arrangement in lines of spirals. The verrucae are low mounds and measure about 1 mm. at the base.

The colour in spirit is orange red.

SPICULES.—The majority of the typical "Blattkeulen" are 0·3 mm. in length and approximately the same in breadth, the breadth varying a good deal more than the length. The leaves are narrow triangular plates quite irregularly arranged and the root is characteristically a convex mass covered with tubercles, that is to say, there are usually no prominent rootlets as in the other species.

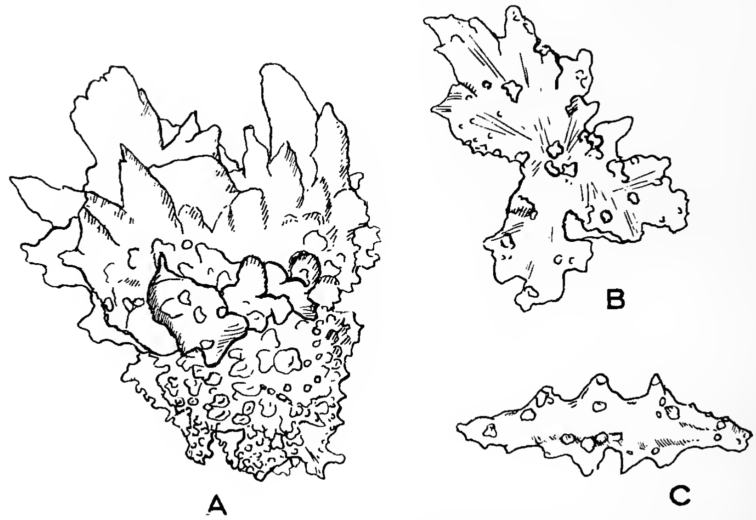
Among the full-grown "Blattkeulen" in a preparation smaller forms may be found 0·2 mm. in length, with three triangular leaves in a row and three pronounced rootlets, and it appears that as this type of spicule grows, the rootlets increase in thickness to form the convex mass without increasing relatively in length (Text-fig. 11).

There are a few capstans (0·1 mm.) in this specimen.

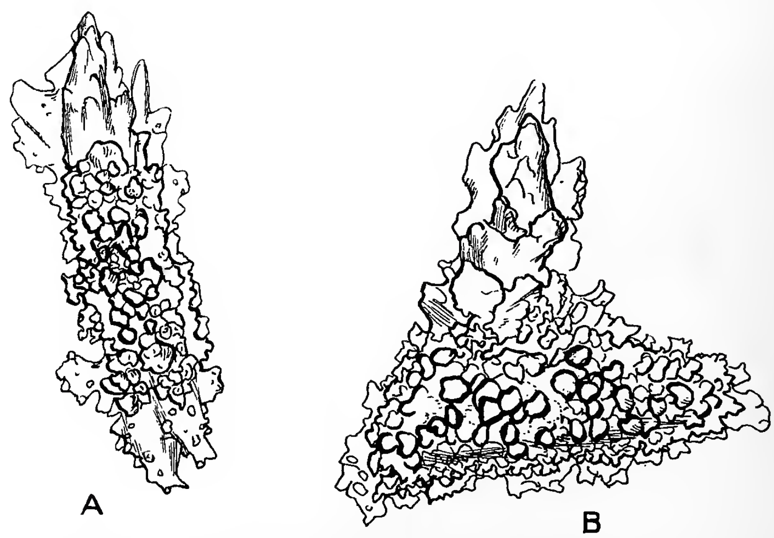
The spindles lie beneath the surface of the coenenchym, and attain to a size of 0·5 mm. in length by 0·15 mm. in maximum thickness. They are not all of a simple spindle shape, as some are forked at one end and some larger at one end than the other. One spicule in my preparation is of almost the exact shape, size and colour as the spicule figured for *E. pseudosassapo* by Kölliker in his pl. xviii, fig. 10.

The intermediates are of immense variety but of great interest. In several of them

one half is like the leaf cluster of a "Blattkeule" and the other half a spindle. The leaf cluster may be terminal so that the spicule is like a torch, or it may arise on one side only of a spindle-shaped base. Several of these are much larger than the typical "Blattkeulen," attaining a size of over 0·45 mm. in breadth × 0·5 mm. in length (Text-fig. 12).



TEXT-FIG. 11.—*Plexauroides rigida.* A, A very large Blattkeule with the roots fused into a dense convex mass. B, A smaller form with two thick irregular roots. C, One of the spindles from the lower layer of the coenenchym. × 200 diam.



TEXT-FIG. 12.—*Plexauroides rigida.* Two spicules of the coenenchym of irregular form. A, A torch. B, A halbseitige Blattkeule. × 100 diam.

All the larger spicules have a faint pink colour, the spindles being usually more darkly stained than the "Blattkeulen."

The polyps are contracted in the specimen, but the apertures of the verrucae are in many cases sufficiently wide to enable a good view to be obtained of the retracted anthocodiae. No group of spicules forming an operculum can be observed in any polyp, nor can any spicules corresponding in form with the polyp spicules of the species of *Echinogorgia*

be seen in the spicule preparations. Dissection of the retracted anthocodiae confirms these observations, and it can be definitely stated that there are no spicules in the anthocodiae and therefore no operculum.

No gonads were found in this specimen.

A smaller specimen (w) from the Penguin Channel, Station IX, consists of a single unbranched stem 70 mm. high springing from a very small disc-shaped base attached to an oyster shell.

The diameter does not exceed 2 mm.

The verrucae are low mounds.

The colour is orange red—almost the same shade as that of the specimen from Station XII.

Spicules.—The "Blattkeulen" agree in form and size with those of the other specimen, and there are several large spindles up to 0·3 mm. in length in the coenenchym. There is no operculum in the polyps.

There can be no doubt that this is a younger colony of the same species as the specimen described above from Station XII.

No gonads were observed.

The type of this species was obtained in 11–12½ metres of water in Shark's Bay, N.W. Australia, and was described by Kükenthal (1910, p. 92).

It was 230 mm. high, was branched in one plane without anastomoses and had an expanse of 110 mm.

The type was therefore much larger than the larger specimen from the Penguin Channel and the ramification much more profuse. Another important point of difference between them is that in the type-specimen the largest spindle-shaped spicules in the coenenchym were only 0·15 mm. in length, whereas in the Penguin Channel specimen there are some 0·5 mm. in length. The colour of the type-specimen was blood red, of our specimen orange red.

On the other hand, they agree in the absence of an operculum and in the form of the "Blattkeulen." The branches in both are circular in section and the diameter of the stem and branches is approximately the same.

Plexauroides praelonga var. *typica*, Ridley.

There are two small specimens dredged in the Penguin Channel, Station XII, which are probably young forms of this variety.

The larger one (z) consists of a stem 95 mm. high with two lateral branches, the longer of which is 50 mm. in length. The diameter of the stem is 3 mm. There is a small base of attachment 9 mm. in diameter without a covering of coenenchym.

The verrucae of the expanded polyps are in the form of low collars. In the contracted polyps these collars are almost flush with the general coenenchym. They are evenly distributed all round the stem and branches but not crowded together.

The colour is orange brown.

Spicules.—The "Blattkeulen" in this species are of the variety called "Schuppenkeulen" by Kölliker, that is to say, they consist of a single broad flat leaf and a root (Text-fig. 13).

In this specimen the prevailing type bears some large tubercles on one side of the leaf

and the root has two or three rootlets. The largest are about 0·4 mm. long × 0·3 mm. broad across the leaf.

Variations from this type show a leaf divided into two or three lobes with or without a crenate margin. In some of these there is a definite keel on the leaf, in others several radiating ridges as shown in Ridley's figure (1884, pl. xviii, *g'*).

The small " Blattkeulen " have a single smooth leaf with two or three rootlets.

There were no capstans in my preparations of this specimen.

There are several large spindle-shaped spicules visible at the surface. They are variable in size up to a maximum of about 0·75 × 0·3 mm. The side of these spicules exposed at the surface bears longer tubercles than the underside, and some of these tubercles are expanded into triangular or more irregular leaf-like processes.

Some of these surface spicules are oval or disc-shaped, approaching the type of spicules of *Euplexaura robusta.*

In the lower layer of the coenenchym and in close contact with the axis there are numerous small white spicules 0·15–0·3 mm. in length of very varied shapes. Some are simple tuberculate spindles, some spindles with one or more long lateral spines, some crosses, some shaped like knuckle-bones.

Text-fig. 13.—*Plexauroides praelonga.* One of the " Blattkeulen " of the coenenchym. × 100 diam.

The retracted anthocodiae are protected by an operculum of bent spindles similar in arrangement to those of the operculum of the smaller specimen.

All the spicules except those of the anthocodiae are yellow, or, when seen in a heap, orange.

In a piece of the axis 0·75 mm. in diameter there is a chambered core 0·45 mm. in diameter with close-set concave septa, and a thin cortex consisting of tightly compressed fibres. It is not loculated. There is a little calcium carbonate in the axis.

The specimen is female, with ova 0·1 mm. in diameter.

A smaller specimen (cc) has a base of attachment 15 × 7 mm., and consists of a stem 74 mm. high with one short branch.

The base and part of the stem bears no coenenchym. Where the latter is complete the stem is 2·5 mm. in diameter. The verrucae are similar in form and distribution to those of the other specimen (z).

The colour is orange red—a much brighter red colour than the other specimen.

Spicules.—Most of the " Blattkeulen " consist of a very thin leaf with a smooth outline. The larger ones bear a few tubercles on the outer side of the leaf but they are not keeled. They usually have three short tuberculated rootlets. The largest " Blattkeulen " are 0·3 mm. in length.

There are no capstans.

There are a few pink spindle-shaped spicules in the coenenchym with a maximum length of 0·4 mm., and in my first preparation there are no large spindles or plates similar to those of specimen z, but on examining a little heap of dried spicules I discovered one large sausage-shaped spicule (1·2 × 0·3 mm. in size) with large tubercles, expanding in some cases to small triangular plates on one side and small tubercles on the other.

The retracted anthocodiae are protected by an operculum consisting of slender bent spindles with a maximum length of 0·15 mm. They have the usual arrangement of a crown of two or three circles of spicules, and eight points of two or three spicules which meet more or less "en chevron."

All the spicules of this specimen, except those of the anthocodiae, are pink. When seen in a little heap they are red.

The specimen is male with testes up to 0·3 mm. in diameter. Some of the testes seem to be almost ripe.

Plexauroides praelonga var. *cinerea*, Ridley.

A specimen (v) from the Penguin Channel (Station XII) agrees very closely with Ridley's description of *P. praelonga* var. *cinerea* from 5–10 fathoms at Port Curtis, Queensland.

It is in two pieces; one with the base is 55 mm. high, and the other, without a base, is 120 mm. high. The diameter in the middle of the latter is 4 mm.

Many of the polyps in this specimen are expanded and the surface of the coenenchym round them is smooth—that is to say, there are no verrucae. The polyps are quite irregularly scattered on all sides of the stem.

The colour might be described in Ridley's words as "dirty grey," but "light dirty grey" in this well-preserved spirit specimen rather than dark dirty grey.

Spicules.—The "Blattkeulen" are variable in form, but the prevailing type has a single thin leaf without keel or ribs, but usually some tubercles on the proximal half, and a root with three rootlets, of which the middle one is frequently longer than the two lateral ones.

There are no "capstans."

There are some spindles in the coenenchym which are very variable in size up to a maximum of about 0·6 mm. These have usually longer tubercles on one side than the other.

In this specimen all the spicules are colourless.

The polyps are expanded but probably somewhat contracted by the reagent. The body measures 0·75 mm. × 0·45 mm. and the tentacles 0·45 mm. in length. The body exhibits two regions—a proximal region about 0·45 mm. in length with a thick wall and a distal thin-walled region about 0·3 mm. in length. The thick-walled region is almost unarmed, only a few scattered spindles being observed; at the junction of the thick and thin-walled regions there are a few spindles arranged transversely, forming a crown; in the thin-walled region there are several spindles arranged roughly parallel with the body, and some of these project into the bases of the tentacles. There are no spicules in the tentacles.

I have described the polyps as they are seen in the preparations, but I think it is possible that in life they were more heavily armed, as the surface epithelium seems to be slightly macerated, and some of the spicules may have been lost before the specimens reached me.

The axis of this specimen gives a strong effervescence when treated with an acid. Apart from the presence of more calcium carbonate which this reaction indicates, the structure of the axis is the same as that of the specimen Z of the other variety.

The specimen is male, with testes up to 0·2 mm. in diameter.

A small specimen (Aa) from the same station probably belongs to this variety of the species.

It has a stem 60 mm. high, with one lateral branch springing at right angles from the stem 50 mm. in length. Near the extremity of the branch it is 2·5 mm. in diameter, but becomes more slender towards the base. None of the polyps are expanded in this specimen, and the verrucae are in consequence more pronounced.

The colour is dirty grey.

Spicules.—The "Blattkeulen" are also very variable in this smaller specimen, but the prevailing type is similar to that of the larger specimen. On comparing a group of spicules of each there are clearly more spicules in the smaller form which are provided with tubercles and ridges on the leaves and have a crenate or dentate leaf margin. Moreover, the rootlets are often more numerous and shorter than in the larger specimen. The smallest "Blattkeulen" have a single broad leaf.

In the smaller specimen also there are some spicules which seem to be a compound of a large spindle with a "Blattkeule" of the general type of Kölliker's "halbseitige Blattkeule."

The spindles of the lower layer of the coenenchym are similar to those of the larger specimen.

Although the majority of the spicules are colourless as in other specimens of this variety, it is of some interest that a few of the spicules in this specimen have a faint pink colour.

The armature of the few contracted polyps examined seemed to be similar to that of the other specimen.

Gonads were not observed.

These specimens agree closely with the description of the two varieties of *Plexaura praelonga* by Ridley (1884, p. 339). The type-specimens of the variety "*typica*" were found in 5–11 fathoms of water, on a bottom of sand and shells at Port Curtis and at Port Denison on a rocky bottom, the variety "*cinerea*" at Port Curtis only.

Wright and Studer (1889, p. 138) transferred the species to the new genus *Plexauroides*, and described a specimen (260 mm. high) from Cape York.

Nutting (1910*b*, p. 10) also described a large red specimen from the Aru Islands.

The new species *Echinogorgia flora* from New Guinea described by Nutting (1910*a*, p. 66) almost undoubtedly belongs to the typical variety of this species of *Plexauroides*. His figure (pl. xi, fig. 2) of *E. flora* shows a Gorgonian very similar to the specimen V of *P. praelonga* from the Penguin Channel, and the spicules of that species, as described by Nutting, agree closely with those of this *Plexauroides*.

The absence of calcareous matter in a specimen is no reason for retaining it in the family Muriceidae, as there is great variation in this respect in the Plexauridae, as shown in the axis of the specimens described above (see also Thomson and Dean, 1931, p. 198). This point, however, is of some general interest, as it is another indication of the very close relations of *Plexauroides* and *Echinogorgia*.

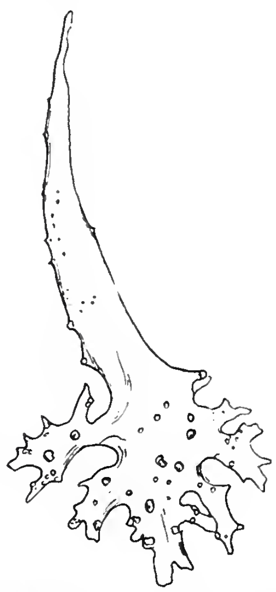
Echinomuricea indo-malaccensis, Ridley.

There is a specimen of this genus from the Penguin Channel, Station IX.

It is 85 mm. high, and has a base of attachment 12 mm. in expanse. The branching is quite irregular and without anastomoses. The base and the lower part of the branches are devoid of coenenchym, and partly enveloped by a mixed population of Polyzoa, sponges and other encrusting organisms (including a species of *Rhabdopleura*). Some of the terminal branches retain the coenenchym, but even this is partly covered by a milk-white encrustation, which consists of white calcareous sand-grains agglutinated together by a kind of slime.

In a word, the specimen looks unhealthy.

However, there is quite sufficient evidence that it is an *Echinomuricea*, and the only specimen of this genus in the collection.



TEXT-FIG. 14.—*Echinomuricea indo-malaccensis*. One of the dagger-shaped spicules on the margin of the verrucae. × 100 diam.

The verrucae are crowded together in some places, but in others there are small stretches of coenenchym between them. The size of the verrucae varies a good deal, but the maximum breadth at the base is about 1 mm. The height of the verrucae depends on the extent of the contraction. The greatest height I have measured is 0·7 mm., but in some verrucae it is less than 0·3 mm. This measurement in contracted spirit specimens is of no specific value, although it might be of some value in specimens with fully expanded polyps.

The calcareous encrustations make it very difficult to determine the surface characters of the verrucae and coenenchym, but I have observed a few dagger-shaped spicules in the coenenchym.

The colour under the encrustations is red.

SPICULES.—The characteristic spicules of this genus are the dagger-shaped spicules, which are found on the edge of the verrucae and more rarely on the coenenchym (Text-fig. 14).

A typical dagger is 0·6 mm. in total length; the blade has smooth edges and is 0·45 mm. in length. At the base of the blade there are a few small pointed tubercles. The hilt consists of 4 or 5 branched, root-like processes.

Other dagger-like spicules have a relatively longer blade or a more complicated hilt, and there is some variation as to the presence of tubercles on the blade. On the whole the blades are remarkably free from such tubercles and have smooth, sharp edges.

Other spicules found in a preparation are the thin bent spindles having a length of about 0·45 mm. and a maximum thickness of 0·03 mm., a number of quite irregular forms and a few crosses.

Nearly all these spicules have a pale pink to a darker orange-pink colour.

The axis is brown, and contains very little calcium carbonate.

The specimen bears male gonads up to 0·27 mm. diameter.

I have examined the type-specimen and its spicules, and there seems to be no reason to separate this specimen from Ridley's (1884, p. 336) *E. indo-malaccensis*, which was found in 5–20 fathoms off the coast of Queensland and in Torres Straits, although it differs from this species by its more irregular branching.

Nutting (1910, p. 56) describes seven species of the genus from the Malay Archipelago and New Guinea. Of his new species, *E. pulchra* from Banda (9–45 metres) has some resemblance to the specimen described above, but I do not consider that there is sufficient reason to separate this species from *E. indo-malaccensis*.

The species was also recorded by Wright and Studer (1889, p. 112) from the Philippines, but according to Hedlund (1890, p. 14), this specimen should be referred to a distinct species, *E. philippinensis*.

Thomson and Henderson (1905, p. 291) recorded the species from the Gulf of Manaar, but the verrucae in their specimens were higher (0·8 mm.) than those of the type (0·3 mm.) and the dagger-shaped spicules rather larger. These differences, however, should not be regarded as of any specific importance. There is a specimen in the collection made by Mr. Bedford at Singapore, of which Mr. Shann made a number of preparations, now in my cabinet. This specimen is undoubtedly identical with that from the Penguin Channel described above as *Echinomuricea indo-malaccensis*.

Genus *Paramuricea* ?

In the collection from the Penguin Channel, Station IX, there is a small Gorgonian which with great hesitation I have assigned to the genus *Paramuricea*. It consists of a single stem 58 mm. high and 1 mm. broad in its greatest diameter, rising from a horny disc of attachment (2·5 mm. diam.) to an oyster shell.

The verrucae are scarcely raised above the surface of the coenenchym, are oval in shape (0·75 × 0·6 mm.), separated by intervals of about 1 mm. but arranged irregularly all round the stem. The coenenchym is very thinly covered with a dense aggregation of spicules.

These spicules are of very variable shape, but some may be seen to be spindles up to 0·3 mm. in length, with large and sometimes branched tubercles. Others are forked, and there are some crosses. They are very difficult to separate in boiling potash, but it seems to be certain that there are some masses of spicules of irregular shape.

The anthocodiae have an armature of narrow, almost smooth spindles about 0·15 mm.

in length, and in retraction they form an operculum very similar to that of some of the species of *Paramuricea*.

The spicules are colourless and the specimen itself light grey.

It is impossible to determine with certainty the generic position of a single specimen of such small size, and a more elaborate study of its structure could not be made without serious mutilation, which did not seem to be justified.

The main point to be emphasized is that it is not a juvenile form of any of the other species described in this paper.

Most of the species attributed to the genus *Paramuricea* are found in European or Atlantic seas. No species have hitherto been described from the Malay Archipelago or from the coasts of Australia.

Family Acanthogorgiidae.

The genus *Acanthogorgia* was formerly included in the family Muriceidae, but was referred to a separate family, together with the genus *Acalycigorgia*, by Kükenthal (1908, p. 37). This rearrangement of the genus was not accepted by Nutting (1910), but the new family name has been more recently adopted by Thomson and Dean (1931). I have already expressed the opinion (1930, p. 250) that the reasons for the separation of the genus from the Muriceidae are not very satisfactory, but may be accepted temporarily until our knowledge of the two families is further extended.

The statement, however, that the species of the family have a purely horny axis (Kükenthal, 1924, p. 237) is subject to some exceptions, as the specimen from the Maldive Archipelago which I described as *Acanthogorgia flabellum* (1905, p. 812) has an axis with a core filled with large calcareous beads. The presence or absence of small calcareous granules in the axis is a character which is too variable for use in the diagnosis of families.

Acanthogorgia studeri, Nutting.

The single small specimen which I attribute to this species was dredged in 20–25 fathoms in the Papuan Pass (Station XXV, 17.iii.29).

It is only 32 mm. high, and consists of a main stem giving off five branches in one plane. It is attached by a small expanded base to a barnacle shell. There are no anastomoses of the branches.

The stem and main branches are of approximately the same thickness. The axis is 0·15 mm. in diameter, and this is covered by a thin transparent coenenchym 0·075 mm. in thickness.

The verrucae stand up from the coenenchym and are quite irregularly arranged, crowded at the distal ends of the branches, scattered on the main stem. They are cylindrical or hemispherical in shape according to their age or degree of contraction. The largest cylindrical form I have measured is 0·65 mm. in height and 0·45 mm. in diameter; the hemispherical or knob-shaped verrucae are about 0·45 mm. in diameter. The spines forming a crown round the top of the verrucae, which are a characteristic feature of the genus, are shorter than in most species.

The colour is pale brown, but the dark gold axis can be seen through the almost transparent coenenchym.

The spicules of the coenenchym are straight or bent spindles of various sizes, up to a maximum of about 0·35 mm. in length by 0·07 mm. in thickness; some of them have very prominent tubercles, as shown in Nutting's figure (1910, pl. xix, fig. 3). In others the tubercles are short convex projections. There are also a few crosses and irregular shaped spicules.

The spicules of the walls of the verrucae are similar to the spindles of the coenenchym. In the cylindrical verrucae they are arranged transversely to the axis of the polyp, in the hemispherical and knob-shaped verrucae more irregularly, with an approach to chevron arrangement in some cases.

The characteristic spicules of the margin of the verrucae consist of a spine 0·3 mm. in length, and a root usually bent at a wide angle to the spine 0·2 mm. in length. Both spine and root bear more tubercles than in this type of spicule of most of the species of this genus.

There are no gonads in this specimen.

The identification of this specimen may be open to some doubt, as it is very small and possibly only a juvenile form of another species.

According to Nutting (1910, p. 20), the type shows anastomoses of the branches to a limited degree, and the verrucae are 2 mm. in height, or more than twice as large as they are in this small specimen, but in the characters of the spicules the specimen agrees more closely with *A. studeri* than with any other species.

A study of the growth stages in a number of specimens of a single species from one locality seems to be necessary before specific determination in this genus can be satisfactorily made. It is probable in this case that the specimen described above is a young growth stage of *A. studeri*, but this species may in its turn be only a growth stage of such a species as *A. laxa*.

The genus has a very wide geographical and bathymetrical distribution and there are 28 species in Kükenthal's list (1924, p. 28). Nutting (1910) describes twelve species from the Malay Archipelago, and to this list Thomson and Dean (1931) add one more. It is rather surprising, therefore, that this is the first record of the occurrence of a species of the genus in Australian waters.

Family Gorgonellidae.

Genus *Juncella*, Val.

The original name given to a species of this genus by Valenciennes in 1855 was *Junceella*. Five years later its form was quite rightly corrected to *Juncella* by Milne Edwards and Haime, and until quite recently the genus has been called *Juncella* in the extensive literature on the subject by subsequent authors. *Juncella* should be retained as a *nomen conservandum*.

The genus can be distinguished from the other genera of the family by the characteristic club-shaped spicules of the outer layer of the coenenchym.

Juncella gemmacea, Valenciennes.

Two pieces of this species were dredged in the Penguin Channel (Station XII). They may be only branches of a large colony, but they are large enough to show the apparently dichotomous branching. The terminal branches of these two specimens have a maximum

length of about 100 mm. They have a diameter of 3·5 mm., including the verrucae, and taper gradually to a blunt point.

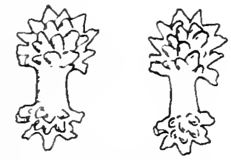
The verrucae are distributed evenly all round the branches, leaving no bare tracks such as are described in many specimens. They are about 2 mm. in length and 0·5 mm. in diameter, and are bent upwards towards the growing point with a slight inward bend. In many places they are so crowded together that they almost overlap.

The colour of these branches is orange red.

The spicules of the outer layer of the coenenchym are of the type, characteristic of the genus, called by Kölliker " unsymmetrische Doppelkeule " and by Simpson " clubs " (Text-fig. 15). They are pale yellow in colour and approximately 0·1 mm. in length. In the inner layer of the coenenchym the spicules are capstans of the type called " Doppelstern " by Kölliker. They are of the same length as the clubs, but colourless.

The figures of these two types of spicules in *Juncella juncea* given by Kölliker (1865, pl. xviii, figs. 45 and 46) resemble very closely the spicules in these specimens.

The specimens are so completely retracted that no parts of the anthocodiae protrude from the mouths of the verrucae, and therefore the only way to study the armature of the anthocodiae is by dissection. The tightly contracted anthocodiae thus released are



TEXT-FIG. 15.—*Juncella gemmacea.* Two of the club-shaped spicules at the surface of the coenenchym. × 200 diam.

colourless and apparently free from spicules. I can find no evidence of the small warted rods which, according to Toeplitz (1929, p. 270), fill the tentacles (erfüllen dicht die Tentakel) in *J. juncea.*

It may be that Simpson and Toeplitz were able to examine the fully expanded anthocodiae of some of the species they described ; but in my experience the description of the armature of the polyps based on the examination of anthocodiae dissected out of tightly contracted verrucae is apt to be very misleading.

The axis has the usual straw colour of the Gorgonellids and gives rapid effervescence in hydrochloric acid. It is deeply grooved for the longitudinal canals. There are twelve grooves in a part of the axis 1 mm. in diameter.

The specimen is male, with testes 0·2 mm. in diameter.

This species was recorded from various localities off the coast of Queensland by Ridley (1884, p. 346), and from the Aru Islands and the Timor Sea by Nutting (1910, p. 20). It was thoroughly investigated by Simpson (1910, p. 294). Toeplitz considered the species to be a variety only of *Juncella juncea,* and this view was accepted by Kükenthal (1924). There can be no doubt that the two species are closely related, but the dichotomous branching of the specimens of *J. gemmacea* forms a sufficiently distinct character to justify their separation for the present.

The specimens from the Penguin Channel differ from most of the descriptions of the species in having no bare tracks between the verrucae. The verrucae are distributed all round the branches.

Genus *Scirpearia*, Studer.

The name *Scirpearia* was first introduced by Cuvier for an Alcyonarian which, by some subsequent authors, was considered to be a Pennatulid and by others a Gorgonian (see Simpson, 1910, p. 307). On the strength of this Nutting declared that the name should be abandoned and most of the species referred to the genus *Scirpearella*. Toeplitz (1929) has, however, expressed the opinion that it should be retained as one of the *nomina conservanda*.

Studer (1878, p. 660) gave a short definition of the genus based on the examination of specimens which were certainly Juncellids.

Simpson (1910, p. 277) after a thorough analysis of the characters of a large number of species, came to the conclusion that *Ctenocella*, *Ellisella* and *Scirpearella* could not be distinguished from one another generically, and united them into the one comprehensive genus *Scirpearia*.

Kükenthal (1924), on the strength of the work of Toeplitz, has resuscitated the genera *Ctenocella* and *Ellisella*.

My own investigations on the materials collected by the Barrier Reef Expedition, and on specimens in my own collection from various localities, lend support to Simpson's view that *Scirpearia*, *Scirpearella* and *Ellisella* cannot be separated, but I would plead for the retention of the genus *Ctenocella* (see p. 509).

The principal differences between *Scirpearia* and *Ellisella* according to Toeplitz are that in *Scirpearia* " die Tentakeln sind bei allen Arten der Gattung bewehrt mit Doppelspindeln, die Uebergange zu Gürtelspindeln zeigen können " (1929, p. 293), but in *Ellisella* "Die Bewehrung der letzteren (*i. e.* the Polyps) geschieht durchweg durch zwei Formen von Spicula, kleine unregelmässig bewartzte Stäbchen in den Tentakeln und stachelige Skleriten in der Polypenbasis " (*loc. cit.*, p. 274).

These statements do not agree with those of Simpson (1910, p. 264), who says that in *Scirpearia* (+ *Ellisella* + *Ctenocella*), " the tentacles bear a number of small flat, scale-like spicules on the aboral surface. These are very easily overlooked in a preparation; and in fact they are so similar *in all species* as to be of no specific importance, so that their inclusion in each individual description is hardly necessary."

A very careful examination of the armature of the anthocodiae of the only specimen in this collection has been made, with the result that, in my opinion, the distinction between the two genera cannot be maintained.

Scirpearia elongata, Pallas.

Two branches of the Juncellid which I have referred to this species were also dredged in Penguin Channel (Station XII).

They are 240 and 190 mm. respectively in length. At the proximal end of the larger one there is a fork, but one of the branches is broken off near its origin, leaving only a short stump. Just below the fork it is 5 mm. in diameter, the axis is 3·5 mm. in diameter and the coenenchym about 0·75 mm. thick. The terminal branches at a distance of 20 mm. from the distal end have the axis 0·75 mm. in diameter and the coenenchym about 0·25 mm. in thickness.

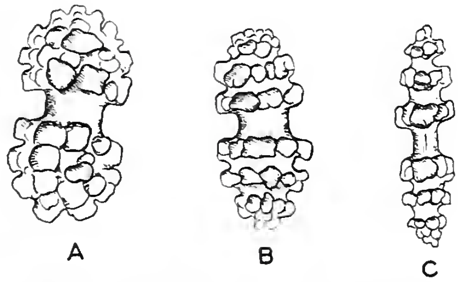
The verrucae are small blunt cones turned slightly upwards, 0·75 mm. in height and about 0·5 mm. in diameter at the base.

They are arranged quite irregularly all round the distal ends of the branches, but in some places near the proximal ends of the branches they are arranged laterally, leaving two broad bare tracks, in one of which there is a shallow groove.

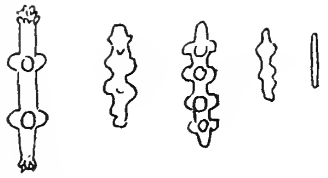
The colour is orange red.

The spicules of the coenenchym consist of "capstans" ("Doppelstern"), and more elongated forms which might be called double clubs. The larger capstans are about 0·058 × 0·054 mm. and the larger double clubs ·07 × ·03 mm. (Text-fig. 16). They agree very closely in form and size with the coenenchym spicules described and figured by Simpson (1910, p. 327, pl. ix, fig. 48) for this species.

It is very difficult to determine the exact arrangement of the spicules of the anthocodiae by dissection of the contracted verrucae. In this specimen there are a few verrucae, from the apertures of which a part of the tentacles protrude, and by the study of these and



TEXT-FIG. 16.—*Scirpearia elongata.* Three spicules of the coenenchym. A, A capstan. B, An intermediate form. C, A double club. × 400 diam.



TEXT-FIG. 17.—*Scirpearia elongata.* Spicules from the aboral side of a single tentacle. × 500 diam.

numerous dissections the following notes have been prepared: (1) The aboral side of the tentacles bears a row of spicules extending from the base to the apex. (2) The pinnules bear no spicules. (3) The thin body-wall of the anthocodia bears a few spicules 0·04 × 0·01 mm. in size, with two girdles of four tubercles and a tuft of small tubercles at each end. (4) Between the base of the body-wall of the anthocodia and the verrucae there is a cluster of small spindle-shaped spicules of various sizes up to a maximum length of about 0·06 mm.

The question whether these spindle-shaped spicules really belong to the anthocodia or the verruca can only be determined by the examination of fully expanded polyps.

The spicules of the tentacles diminish in size from the base to the apex, where they are, as Simpson described them, thin scales (Text-fig. 17). In the basal parts they vary in form, some being double clubs, some with regular girdles, and some with irregularly distributed tubercles; in fact spicules corresponding in form with the spicules of the tentacles figured by Toeplitz for both genera (*Scirpearia* and *Ellisella*) can be seen in one tentacle of this species.

The axis is straw-coloured and highly calcified. In a section of a decalcified branch 1·8 mm. in diameter between the verrucae, the axis is 1·3 mm. in diameter and the coenenchym 0·25 mm. thick and there are twelve longitudinal canals, of which two on opposite sides of the branch are much larger than the others.

The specimen is female with small ovaries. One or two ova 0·2 mm. in diameter were found, but in most cases the ova did not exceed 0·1 mm.

This species is supposed to be identical with the *Gorgonia elongata* of Pallas. The specimens have been referred to it with some hesitation, but after a careful consideration of the extensive literature on the family, I have come to the conclusion that these Juncellids are far more variable than they are generally assumed to be, and that most of the new species that have been proposed are only local variations of one wide-spread species.

Simpson (1910, p. 325) has given a full account of a specimen of this species from the West Indies in the collection of the Royal College of Surgeons, and if the specimens described above are the terminal branches of a much larger colony, they agree closely with this description in all essential characters. The only species of the genus which has been recorded from the Barrier Reef is *Ellisella calamus* (Ridley, 1884, p. 348), referred by Simpson to the genus *Scirpearia.*

The species was referred back to the genus *Ellisella* by Toeplitz, and our specimens agree with his definition of that genus in having spicules in the verrucae of the same kind as those in the general coenenchym, but differ from it in having much more slender branches and a relatively thin coenenchym.

There is apparently no sound specific difference between the specimens from the Penguin Channel and the specimen of *Scirpearia elongata* from the West Indies in the Hunterian Museum described in detail by Simpson (1910, p. 326). It is possible that when fully expanded specimens of the *Scirpearias* from these two widely separated localities can be examined and the armature of the polyps accurately determined, some important differences between them may be discovered.

But until this time the species must be considered to have a very wide geographical distribution with only slight local variations.

Ctenocella pectinata, Pallas.

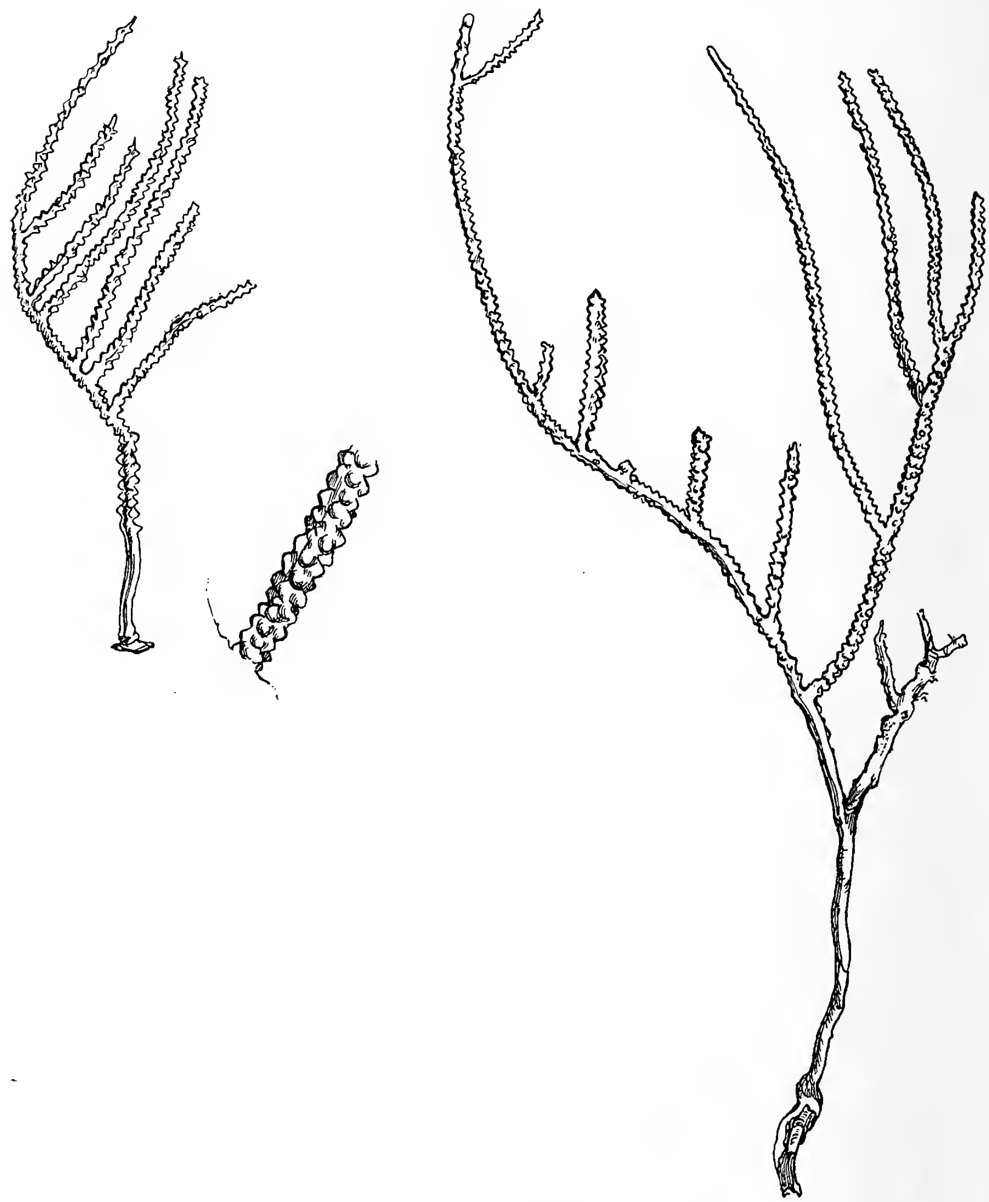
A fine specimen of this well-known species was found in 7 fathoms of water inside the Wentworth Reef (Station XI, 23.ii.29) (Text-fig 18). The Wentworth Reef is a submerged patch of coral near Port Douglas. This is the specimen figured by Dr. Yonge on his pl. xxxix A, opp. p. 133, as a "horny coral or Gorgonid." Two small specimens, probably of the same species, were also obtained from the Penguin Channel (Station XII) on the following day.

The large specimen is about 600 mm. high and has an expanse across the shoulders of about 250 mm. The thickest part of the stem is 30 mm. in diameter and the branches about 2·5 mm. in diameter. The verrucae are low mounds, and about 1 × 0·75 mm. in size at the base. The arrangement of the verrucae varies in different parts of the same branch. In some places there is a distinct bare track on both sides between two lateral groups of verrucae; in others there is no bare track on one side, and in considerable lengths the verrucae entirely surround the branches. In some places the verrucae are arranged in a spiral manner round the branches but in others the arrangement is quite irregular.

The colour of these specimens is red.

TEXT-FIG. 18.—*Ctenocella pectinata.* From a photograph of the large specimen from Wentworth Reef. $\times \frac{1}{3}$.

The spicules of the coenenchym agree very closely with the description given of them by Simpson. They differ from the spicules of the specimen of *Scirpearia* in having a narrower band between the stellate extremities, and in many cases odd tubercles are found on the bar itself (Text-fig. 20). They are approximately 0·057 mm. in length.



TEXT-FIG. 19.—*Ctenocella pectinata*. Two young specimens. The one on the right is T_1, and the one on the left is T_2. Nat. size. At the side of T_2 there is a part of a branch enlarged.

There is no satisfactory account of the spicules of the anthocodiae of this genus or species. According to Simpson (1910, pp. 264), they are similar to those of the species of *Scirpearia*. According to Toeplitz (1929, p. 319 and 327), the tentacles bear slender rod-shaped sclerites 0·046 mm. in length. I have found some spicules similar in size and shape to those described by Toeplitz, but in my dissections of these small, tightly contracted verrucae it was not possible to obtain a clear idea of the armature of the anthocodiae when

expanded. The polyp cavities were filled with nearly ripe testes with a maximum diameter of 0·5 mm.

The two small specimens from Station XII present some features of interest (Text-fig. 19).

The larger one (T_1), having no base of attachment, is 140 mm. high. The lower part of the stem is dead, the coenenchym being brown and degenerate. It divides, 40 mm. from the lower end, dichotomously, but one of the two branches is also dead 30 mm. in length and covered with epizoites.

The other branch, however, is normal, and at a distance of 15 mm. from the fork divides again dichotomously, to give rise to an almost typical bipectinate flabellum, the secondary branches arising on the inner side of the two main divisions of this branch.

No gonads were observed in this specimen.

The smaller one (T_2) is 80 mm. high and has a small base of attachment 3 mm. in diameter. The form of this specimen may be said to be mono-pectinate. The main stem at a distance of 25 mm. from the base bends sharply to one side, and on the opposite side to the bend gives rise to six secondary branches 25–35 mm. in length.

The specimen is a female with ova up to 0·45 mm. in diameter.

These two specimens are smaller than any of those examined by Simpson (1910, p. 320), which were apparently all normal in their bipectinate form.*

The larger form is of interest, as it shows that having failed at the first attempt to form a bipectinate flabellum owing to the death of one of its branches, it has made by another dichotomy a second and successful attempt.

The smaller one, although abnormal, shows the characteristic branching from one side only of a typical flabellum.

These young forms seem to indicate that in this genus the bipectinate form of growth is an important genetic character which manifests itself at an early stage in development.

This well-known species has been previously described by several authors from Australian waters. It is distributed throughout the Malay Archipelago to the coasts of Burma, and has been found in various localities in the Indian Ocean. The same species also occurs in the West Indies (Ridley, 1884, p. 349).

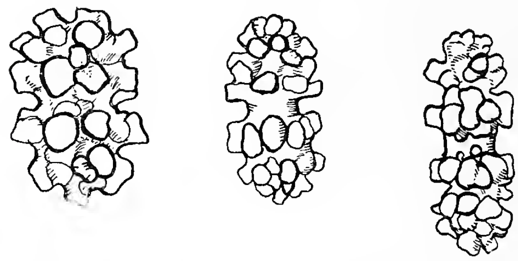
There can be no doubt that the genus *Ctenocella* is closely related to *Scirpearia*, and that there is great force in Simpson's (1910, p. 277) arguments in favour of the inclusion of the species in the genus *Scirpearia*. The unique and characteristic method of branching, usually called "lyre form," or better, "bipectinate," is so definite and easily recognized that it is convenient to keep the species in a distinct genus. This is not the only reason, nor a sufficient one in itself, to justify the retention of the genus. As Simpson (*loc. cit.*, p. 318) points out, there is a difference between this species and *Scirpearia* in the spiculation. This difference might easily be overlooked, because at first sight the spicules of a *Scirpearia* and a *Ctenocella* seem to be exactly alike in size and in outline, but, as Ridley pointed out (1884, p. 349), in *Ctenocella pectinata* the two inner whorls of the verruca spicules almost meet in the middle, "so as to obliterate the median bare zone, which is characteristic of the cortical spicules" (Text-fig. 20).

After a careful examination of several preparations of the *Scirpearia* and of each

* There is some confusion in Simpson's table of measurements, as in the column of the diameter of the main stems *cm.* is probably a misprint for *mm.* A main stem 3 cm. in length by 10·5 cm. in diameter is impossible.

of the three specimens of *Ctenocella* in the collection, I can not only confirm Ridley's observation, but find a further difference in that the bare zone of the ordinary cortical spicules is usually narrower and more frequently partially obliterated by the presence of odd tubercles on it.

In comparing the canal system of these specimens of *Ctenocella* with that of the specimen of *Scirpearia,* I have observed a difference between them which may be of some importance. In a terminal branch of *Ctenocella* there are two very large longitudinal



TEXT-FIG. 20.—*Ctenocella pectinata.* Spicules of the coenenchym. × 400 diam.

vessels connected by a network of capillaries. In a branch of *Scirpearia* of the same diameter there are two large longitudinal vessels, as well as several smaller longitudinal vessels surrounding the axis.

It is possible that further investigation will emphasize the difference between the two genera, as we have very little information concerning many important features of their anatomy. There is no satisfactory account, for example, of the armature of the expanded anthocodiae of *Ctenocella,* and the short statements that have been made on this character are not in agreement (see Toeplitz, 1929, p. 323).

Until the time when fully expanded specimens of the two genera have been examined and described it is better to retain the genus *Ctenocella,* rather than merge this interesting species with those of *Scirpearia.*

5. REFERENCES.

BROCH, H. 1916. Swedish Scientific Expeditions to Australia. XI. Alcyonarien. K. Svenska Vetensk-Akad. Handl. LII, No. 11, pp. 48, pls. i–iv, text-figs. 1–62.

DENDY, A., and NICHOLSON, J. W. 1917. On the Influence of Vibrations upon the Form of Certain Sponge Spicules. Proc. Roy. Soc. B. LXXXIX, pp. 573–587, text-figs. 1–15.

ESPER, E. J. C. 1797[–1806]. Fortsetzungen der Pflanzenthiere. 2 Thl. Nürnberg.

GORDON, I. 1926. Notes on a Number of Muriceid Genera with Special Reference to Spiculation. Proc. Zool. Soc. Lond. 1926, pp. 509–531, text-figs. 1–15, pl. i.

HEDLUND, G. 1890. Einige Muriceiden, etc. Bih. K. Svenska VetenskAkad. Handl. XVI, Afd. iv, No. 6, pp. 18, pls. i–iii.

HICKSON, S. J. 1905. The Alcyonaria of the Maldives. Fauna and Geog. of the Maldive and Laccadive Archipelagoes, II, pp. 808–826, pl. lxvii.

—— 1928. The Gorgonacea of Panama Bay. Vidensk. Medd. naturh. Foren. Kjöb. LXXXV, pp. 325–422, text-figs. 1–37, pls. iv–vi.

—— 1930. On the Classification of the Alcyonaria. Proc. Zool. Soc. Lond. 1930, pp. 229–252, text-figs. 1, 2.

HILES, I. L. 1899. Report on the Gorgonacean Corals collected . . . at Funafuti. Proc. Zool. Soc. Lond. 1899, pp. 46–54, pls. i–iv.

KÖLLIKER, A. 1865. Icones Histiologicae, pp. iv + 181, 19 pls.

Kükenthal, W. 1909. Japanische Gorgoniden II Teil. Die Familien der Plexauriden, Chrysogorgiiden und Melitodiden. Abh. Bayer Akad. Wiss. Suppl. I, Abth. 5, pp. 1–78, text-figs. 1–94, pls. i–vii.

—— 1910. Alcyonaria. Die Fauna Südwest-Australiens. Von W. Michaelsen und R. Hartmeyer. III, Lfg. 1, pp. 1–108, pls. i–iv, text-figs. 1–52.

—— 1919. Gorgonaria. "Valdivia" Reports, XIII, T. 2, pp. viii + 946, text-figs. 1–318, pls. xxx–lxxxix.

—— 1924. Gorgonaria. Das Thierreich, 47, pp. xxviii + 478, text-figs. 1–209.

Nutting, C. C. 1910*a*. The Muriceidae. M. Weber. Siboga-Expeditie. Monog. XIII*b*, pp. 108. pls. i–xxii.

—— 1910*b*. The Plexauridae. M. Weber. Siboga-Expeditie. Monog. XIIIb^1, pp. 20, pls. i–iv.

—— 1910*c*. The Gorgonellidae. M. Weber. Siboga-Expeditie. Monog. XIIIb^3, pp. 39, pls. i–xi.

—— 1911. The Scleraxonia. W. Weber. Siboga-Expeditie. Monog. XIIIb^5, pp. 62, pls. i–xii.

Pallas, P. S. 1766. Elenchus zoophytorum, pp. 28 + 451.

Ridley, S. O. 1882. Contributions to the Knowledge of the Alcyonaria. Part II. Ann. Mag. Nat. Hist. (5), X, pp. 125–133, pl. v, 2 text-figs.

—— 1884. Alcyonaria. Report on the Zoological Collections of H.M.S. "Alert," pp. 327–365, pls. xxxvi–xxxviii.

Simpson, J. J. 1909. *See* Thomson and Simpson.

—— 1910*a*. A Revision of the Gorgonellidae. I. The Juncellid Group. Proc. Roy. Irish Acad. XXVIII, Sect. B, pp. 247–386, pls. i–xix.

—— 1910*b*. *Hicksonella*, A New Gorgonellid Genus. J. Roy. Micr. Soc. 1910, pp. 681–692, pl. xiii.

Stephenson, T. A., and Stephenson, A. 1931. The Structure and Ecology of Low Isles and Other Reefs. Gt. Barrier Reef Exped. 1928–29. Sci. Rep. III, No. 2, pp. 1–112, text-figs. 1–15, pls. i–xxvii.

Studer, Th. 1878. Uebersicht der Anthozoa Alcyonaria . . . der Reise S.M.S. "Gazelle." Mber. Akad. Wiss. Berlin, pp. 632–688, pls. i–v.

Thomson, J. A., and Henderson, W. D. 1905. Report on the Alcyonaria. Ceylon Pearl Oyster Fisheries. Suppl. Reports. Part III, pp. 269–328, pls. i–vi.

Thomson, J. A., and Simpson, J. J. 1909. An Account of the Alcyonarians Collected by the . . . "Investigator." Part II. The Alcyonarians of the Littoral Area. Pp. xviii + 319, text-figs. 1–77, pls. i–ix.

Thomson, J. A., and Dean, L. 1931. Alcyonacea with an Addendum to the Gorgonacea. M. Weber. Siboga-Expeditie. Monog. XIII*d*, pp. 227, pls. i–xxvii.

Toeplitz, Ch. 1929. Die Gorgonarien Westindiens. 7. Die Familie Gorgonellidae, zugleich eine Revision. Zool. Jahrb. Suppl. XVI, pp. 235–376, text-figs. 1–26, pls. vi, vii.

Woodland, W. 1905. Studies in Spicule Formation. II. Spicule Formation in *Alcyonium digitatum*. Quart. J. Micr. Sci. XLIX, pp. 283–304, text-figs. A–C, pls. xvi, xvii.

Wright, E. P., and Studer, Th. 1889. Alcyonaria. "Challenger" Reports—Zool. XXXI, pp. lxxii + 314, pls. xlix, text-illust.

Yonge, C. M. 1930. A Year on the Great Barrier Reef. London, pp. xx + 246, 83 pls., 6 maps.

INDEX

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 11

SPONGES

BY

MAURICE BURTON, M.Sc.,

Assistant Keeper in the Department of Zoology

WITH THIRTY-THREE TEXT-FIGURES AND TWO PLATES

LONDON

PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM

SOLD BY

B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4

AND AT

THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7

1934

Price Seven Shillings and Sixpence

January, 1934]

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV. No. 14

SPONGES

BY

MAURICE BURTON, M.Sc.,
Assistant Keeper in the Department of Zoology

WITH THIRTY-THREE TEXT-FIGURES AND TWO PLATES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W. 1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W. 1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C. 4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W 7
1934

Price Seven Shillings and Sixpence

[*Issued 27th January, 1934*]

ADLARD & SON, LTD.
21, HART STREET, W.C.

Made and printed in Great Britain.

SPONGES

BY

MAURICE BURTON, M.Sc.,
Assistant Keeper in the Department of Zoology.

WITH THIRTY-THREE TEXT-FIGURES AND TWO PLATES.

INTRODUCTION.

The study of the collection of sponges brought home by the Great Barrier Reef Expedition has added few new names to our lists of the Australasian species, but has provided a valuable addition to our knowledge of the fauna of the Australian coasts. Practically nothing was known hitherto of the sponge-fauna of the Great Barrier Reef. But more valuable still is the opportunity afforded to overhaul our knowledge of the sponges of this region, especially with regard to their nomenclature.

The sponges collected by the Expedition belong, for the most part, to species characteristic of the Indo-Pacific. Many of these are common also to the coasts of Australia, and the results of the present investigation suggest that, in the region explored, a mixing of the Australian and Malayan sponge-faunas takes place. This broad generalization, in itself inconclusive and unsatisfactory, is the most that can be said. A more detailed

analysis is impossible until our knowledge of the sponge-fauna of Australia is brought up to date, for, although a formidable list of species has been recorded from various parts of the Australian coast, most of them are either inadequately described or wrongly classified.

There are two further points worthy of mention here. In the first place, the species represented in a collection made by Savile Kent in some unstated part of the Barrier Reef are predominantly Australian, in striking contrast to the collection made by the present Expedition. It is probable, therefore, that the generalization made above regarding the Low Isles area is not true of the whole of the Barrier Reef. The second point concerns the occurrence of species on the Barrier Reef which are also found in the West Indies, Azores and Mediterranean. Although it is not possible here to enter into details, this raises a problem of first-rate importance which would justify close investigation. When we turn to the sponge-faunas of the Indian Ocean and the Malay area we find that there are many species showing this same distribution. So far as can be seen at present, the line of their distribution follows through from the Malay area and Indian Ocean, round the most southerly point of the African continent, up its west coast to the Azores and thence into the West Indies on the one hand and the Mediterranean on the other. Moreover, these same species do not seem to occur outside this area. It is possible that a detailed study of this problem may shed interesting light on the migration of species and the factors limiting distribution.

The ecology of some of the sponges has been dealt with in Vol. III, No. 2, of the Barrier Reef Reports, but since that report was published certain of the names have been altered.

These, with their present equivalents, are given below :

Names used in Vol. III, No. 2.		Names used in present Report.
Chalina clathrata	=	*Haliclona clathrata* (Dendy).
C. camerata	=	*H. camerata* (Ridley).
Gellius toxius	=	*Adocia toxius* (Topsent).
G. sagittarius	=	*A. sagittaria* (Sollas).
G. pumilus	=	*A. pumila* (Lendenfeld).
G. fibulatus	=	*A. fibulatus*, var. *microsigma*, Dendy.
Cladochalina pulvinatus	=	*Callyspongia diffusa* (Ridley).
Polymastia sp.	=	*P. megasclera*, sp. n.
Phyllospongia foliascens	=	*Carterispongia foliascens* (Pallas).
P. ridleyi	=	*Druinella ramosa*, Thiele.
Euspongia irregularis, var. *pertusa*	=	*Spongia officinalis*, Linnaeus.
Spongelia digitata	=	*Dysidea fragilis* (Montagu).

TABLE SHOWING DISTRIBUTION OF SPECIES COLLECTED BY THE EXPEDITION ON THE GREAT BARRIER REEF.

Species.	Australia.				Malay area.	Indian Ocean, including Red Sea.	Further distribution.
	North coast.	East coast.	South coast.	West coast.			
ORDER CALCAREA	..	..	..	..	..	..	..
Family LEUCASCIDAE	..	..	..	..	..	..	..
Pericharax heteroraphis (Poléjaeff)	..	..	..	..	×	×	Tristan da Cunha.
Family SYCETTIDAE	..	..	..	..	..	..	..
Sycon gelatinosum (Blainville)	..	×	×	×	×	..	..
Family HETEROPIIDAE	..	..	..	..	..	..	..
Leuconia ramosa, sp. n.	..	..	..	..	..	..	..
ORDER TETRAXONIDA	..	..	..	..	..	..	..
SUB-ORDER HOMOSCLEROPHORA	..	..	..	..	..	..	..
Family PLAKINIDAE	..	..	..	..	..	..	..
Corticium candelabrum, Schmidt	..	..	..	..	×	..	Mediterranean.
Oscarella tenuis, Hentschel	..	..	×	×	..	..	..
SUB-ORDER ASTROSCLEROPHORA	..	..	..	..	..	..	..
Family STELLETTIDAE	..	..	..	..	..	..	..
Stelletta purpurea, Ridley	×	×	..	..	×	×	Antarctic; New Zealand.
S. clavosa, Ridley	×	..	..	×	×	×	..
Ancorina agglutinans (Thiele)	..	..	..	..	×	..	..
Jaspis stellifera (Carter)	×	..	×	..	..	..	..
Family CHONDROSIIDAE	..	..	..	..	..	..	..
Chondrilla nucula, Schmidt	×	×	..	..	×	×	New Zealand; Azores; W. Indies; Mediterranean.
C. australiensis, Carter	..	×	..	..	×	×	..
SUB-ORDER SIGMATOSCLEROPHORA	..	..	..	..	..	..	..
Family TETILLIDAE	..	..	..	..	..	..	..
Cinachyra australiensis (Carter)	..	×	×	..	×	×	Philippines.
Raphidotethya enigmatica, sp. n.	..	..	..	..	..	..	..
Family HAPLOSCLERIDAE	..	..	..	..	..	..	..
Haliclona camerata (Ridley)	..	..	..	..	×	×	..
H. reticulata (Lendenfeld)	..	×	..	..	..	× ?	..
H. clathrata (Dendy)	..	..	×	..	×	..	New Zealand.
H. exigua (Kirkpatrick)	..	..	..	..	×	..	..
H. pigmentifera (Dendy)	..	..	..	..	..	×	..
H. tenuispiculata, sp. n.	..	..	..	..	..	..	..
H. flabello-digitatus, sp. n.	..	..	..	..	..	..	..
Adocia toxius (Topsent)	..	..	..	..	×	×	..
A. minor (Dendy)	..	..	..	..	..	×	..
A. obtusa (Hentschel)	..	..	..	..	×	..	..
A. pumila (Lendenfeld)	×	..	..	..	×	×	..
A. sagittaria (Sollas)	..	..	..	..	×	..	..
A. fibulatus, var. *microsigma*, Dendy	..	..	..	..	..	×	..
Petrosia strongylata, Thiele	..	..	..	..	×	..	..
Callyspongia diffusa (Ridley)	..	..	..	..	×	..	..
C. subarmigera (Ridley)	×	×	..	..	×	..	..
C. fibrosa (Ridley and Dendy)	..	..	..	..	×	×	..
C. confoederata (Ridley)	×	×	..	×	×	..	..

Species.	Australia. North coast.	Australia. East coast.	Australia. South coast.	Australia. West coast.	Malay area.	Indian Ocean, including Red Sea.	Further distribution.
ORDER TETRAXONIDA—*cont.*							
SUB-ORDER SIGMATOSCLEROPHORA—*cont.*							
Family HAPLOSCLERIDAE—*cont.*							
C. clathrata (Dendy)	..	..	..	..	..	×	..
C. ridleyi, sp. n.	..	×	..	..	..	..	..
Oceanapia fistulosa (Bowerbank)	×	..	..	×	×	×	Azores; Bahia.
O. renieroides, sp. n.	..	..	..	..	..	..	..
O. elastica (Keller)	..	..	..	..	×	×	..
Family DESMACIDONIDAE	..	..	..	..	..	..	..
Section ISODICTYEAE	..	..	..	..	..	..	..
Desmapsamma, gen. n., *anchorata* (Carter)	..	..	..	..	×	..	West Indies; Bahia.
Section MYCALEAE	..	..	..	..	..	..	..
Mycale grandis, Gray	..	..	..	..	×	..	..
M. sulevoidea (Sollas)	..	..	..	..	×	..	..
Section MYXILLEAE	..	..	..	..	..	..	..
Histoderma calcifera, sp. n.	..	..	..	..	..	..	..
Hamigera strongylata, sp. n.	..	..	..	..	..	..	..
Plumocolumella anchorata (Carter)	..	..	×	..	..	..	..
Strongylacidon inaequalis (Hentschel)	..	..	×	×	..	..	..
S. intermedia, sp. n.	..	..	..	..	..	..	..
Psammochela fibrosa (Ridley)	×	..	..	..	..	×	..
Chondropsis chaliniformis (Carter)	×	×	×	..	..	..	Antarctic.
C. carcinophila (Lendenfeld)	..	×	..	..	..	..	..
Iotrochota purpurea (Bowerbank)	..	..	..	..	×	×	..
I. coccinea (Carter)	..	..	×	..	..	..	..
Crella spinulata (Hentschel)	..	..	×	×	..	..	..
Hymedesmia mertoni, Hentschel	..	..	..	..	×	..	..
H. tenuissima (Dendy)	..	..	..	..	..	×	..
Paracornulum dubium (Hentschel)	..	..	..	..	×	..	..
Section CLATHRIEAE	..	..	..	..	..	..	..
Clathria aculeata, Ridley	×	..	..	..	..	..	..
C. rubens (Lendenfeld)	..	×	..	..	..	..	..
C. eccentrica, sp. n.	..	..	..	..	..	..	..
Tenacia frondifera (Bowerbank)	×	..	..	..	×	×	..
T. procera (Ridley)	×	..	..	..	..	×	..
T. paucispina (Lendenfeld)	..	×	..	..	..	..	..
T. coralliophila (Thiele)	..	..	..	..	×	..	..
Ophlitaspongia rimosa (Ridley)	..	..	..	..	..	×	..
O. eccentrica, sp. n.	..	..	..	..	..	..	..
Protophlitaspongia, gen. n., *oxeata*, sp. n.	..	..	..	..	..	..	..
Echinochalina intermedia (Whitelegge)	..	×	..	..	..	×	..
E. anomala, Hallmann	..	×	..	..	..	..	..
Coelocarteria, gen. n., *singaporense* (Carter)	..	..	..	..	×	..	..
Family AXINELLIDAE	..	..	..	..	..	..	..
Trachyopsis aplysinoides (Dendy)	..	..	..	..	..	×	..
T. halichondrioides, Dendy	..	..	..	..	..	×	..
Leucophloeus fenestratus, Ridley	×	..	..	..	×	..	..

Species.	Australia.				Malay area.	Indian Ocean, including Red Sea.	Further distribution.
	North coast.	East coast.	South coast.	West coast.			
ORDER TETRAXONIDA—*cont.*							
SUB-ORDER SIGMATOSCLEROPHORA—*cont.*							
Family AXINELLIDAE—*cont.*							
Ciocalypta penicillus (Bowerbank)	×	×	×	×	×	×	Eastern Atlantic, from N. Europe to S. Africa.
Collocalypta mertoni (Hentschel)	..	..	..	..	×	..	..
Acanthella cavernosa, Dendy	×	..	..	..	..	×	..
Pararhaphoxya, gen. n., *tenuiramosa*, sp. n.	..	..	..	..	..	..	..
Family CLAVULIDAE	..	..	..	..	..	..	..
Pseudosuberites andrewsi, Kirkpatrick	..	..	..	..	×	..	..
Laxosuberites proteus, Hentschel	..	×	×	..	..	×	..
Polymastia megasclera, sp. n.	..	..	..	..	..	..	..
Tethya robusta (Bowerbank)	×	×	×	×	×	×	..
T. japonica, Sollas	..	..	..	..	×	×	..
Tethyorrhaphis oxyaster, sp.n.	..	..	..	..	..	..	..
Timea stellata (Bowerbank)	..	..	..	..	..	..	Europe.
Spirastrella inconstans (Dendy)	..	..	..	..	..	×	..
S. aurivillii, Lindgren	..	..	..	..	×	..	..
S. semilunaris, Lindgren	..	..	..	..	×	..	..
ORDER KERATOSA	..	..	..	..	..	..	..
Family SPONGIIDAE	..	..	..	..	..	..	..
Phyllospongia dendyi, Lendenfeld	..	..	..	×	..	..	..
Carterispongia foliascens (Pallas)	×	×	×	×	×.	×	New Zealand (?); Tropical Pacific (?).
C. vermicularis (Lendenfeld)	..	..	..	×	..	..	..
C. clathrata (Carter)	..	×	×	×	..	×	W. Indies.
Spongia officinalis, Linnaeus	?	?	?	?	×	×	W. Indies; Mediterranean.
S. nardorus (Lendenfeld)	×	..	×	..	..	..	..
Thorectopsamma, gen. n., *irregularis*, sp. n.	..	..	..	..	..	..	..
Hircinia irregularis (Poléjaeff)	×	×	..	..	..	..	..
H. echinata, Keller	..	..	..	..	..	×	..
H. ramosa, Keller	..	..	..	..	..	×	..
H. pinna, Hentschel	..	..	..	..	×	..	..
H. ramodigitata, sp. n.	..	..	..	..	..	..	..
H. aruensis, Hentschel	..	..	..	..	×	..	..
H. dendroides (Poléjaeff)	..	×	..	..	×	×	..
Dysidea fragilis (Montagu)	×	×	×	..	×	×	Europe.
D. reticulata (Thiele)	..	..	..	×	×	..	..
D. herbacea (Keller)	..	..	×	..	×	×	..
Family APLYSINIDÆ	..	..	..	..	..	..	..
Luffariella variabilis (Poléjaeff)	..	..	..	..	×	..	..
Aplysina mollis, var. *aruensis*, Hentschel	..	..	..	..	×	..	..
Druinella purpurea (Carter)	×	..	..	×	..	×	..
D. ramosa, Thiele	..	..	..	..	×	..	..
Family APLYSILLIDAE	..	..	..	..	..	..	..
Aplysilla rosea (Barrois)	..	×	..	..	..	..	..
Dendrilla membranosa (Pallas)	×	..	..	..	×	×	Antarctic: S. America.
Basta flabelliformis (Pallas)	×	×	..	×	×	×	Philippines.

SYSTEMATIC NOTES ON THE COLLECTION OBTAINED BY THE GREAT BARRIER REEF EXPEDITION.

Order CALCAREA.

Family Leucascidae.

Genus *Pericharax*, Poléjaeff.

Pericharax heteroraphis (Poléjaeff).

P. carteri, var. *heteroraphis*, Poléjaeff, 1884, p. 66, pl. ii, fig. 5, pl. vii, fig. 8; *P. heteroraphis*, Dendy, 1913, p. 13; *P. peziza*, *idem*, *l. c.*, p. 15, pl. i, fig. 9; pl. v, figs. 3, 4; Burton, 1930, p. 3.

Occurrence.—Stn. XXIV, 13th March, 1929; $\frac{3}{4}$ mile N.E. of Pasco Reef, $16\frac{1}{2}$ fath., hard and shelly. Stn. XXV, 17th March, 1929: In Papuan Pass, 20–25 fath., foraminifera and shell fragments.

Remarks.—The holotype of *P. heteroraphis* is a subspherical sponge with a broad rooting attachment. There is an apical oscule, with margins produced into a low collar-like elevation, leading into a spacious gastral cavity with the patent openings of the exhalant canals distributed evenly over the surface. These have an average diameter of 1 mm. and are 1 mm. distant from each other. The outer surface of the sponge is finely porose, in some places smooth to the touch, in others harsh. The harshness is due to the projecting ends of the rays of the large triradiates.

The specimen assigned by Dendy to *P. heteroraphis* is practically globular, with an apical oscule, the margins of which do not extend above the general level of the surface. The surface itself is like that of the type in appearance, but more noticeably glabrous and almost without harshness to the touch. The openings into the cloacal cavity are arranged in irregular groups, situated at varying distances from each other, and have an average diameter of 2 mm.

Of the "Siboga" specimens assigned to this species (Burton, *loc. cit.*) two are like the holotype, but the majority of them have given rise "either by budding or by the coalescence of adjacent individuals . . . to masses of rounded lobes". The surface is entirely glabrous, the oscule without projecting margin and the exhalant openings lining the clòaca arranged as in the type. There is one exception to this, among the "Siboga" sponges, an irregularly lobose sponge, very harsh to the touch, with oscules surrounded by a membranous collar. It differs from all other specimens in that each oscule leads into a shallow cloaca formed by the confluence of several large exhalant canals. The colour in the type is a light greyish-brown; in the "Sealark" specimen, grey; in the typical "Siboga" specimens yellow, strongly tinged with a purplish brown, and in the atypical, lobose specimen referred to, light yellow.

The type of *P. peziza* is a regular cup-shaped sponge, with surface smooth and porose and with the mouth of the cup fringed with the remains of a membranous collar. The inner wall of the cup (*i.e.* the cloacal cavity) is covered with exhalant openings of the same size and distribution as in the type of *P. heteroraphis*. In describing *P. peziza*, Dendy stated that it "is distinguished from *P. heteroraphis* chiefly by its remarkable external form". Actually this external form, regarded by him as of such significance, is merely a simple modification of the typical form, and since the form of the species is now

shown to be variable there is no justification for retaining Dendy's name, especially as it can also be shown that the skeleton contains nothing worthy of specific distinction.

The first of the Barrier Reef specimens is incomplete, but evidently had much the same shape as the type of *P. heteroraphis*. It was probably about 4 cm. in diameter (about three times the size of the type) and the openings lining the cloacal cavity are correspondingly larger. The surface is very harsh to the touch, and the colour is a greyish-yellow. The second specimen consists of three coalescent individuals, the cloacal cavities of which have no connection with each other: the larger of these is damaged, but evidently had a similar form to the type of *P. peziza*; the second is intermediate in form between the largest individual and the type of *P. heteroraphis*; and the third is small, strongly recalling one of the lobes of the atypical "Siboga" specimen. This specimen proves, if any further proof were needed, that *P. peziza*, the type of *P. heteroraphis* and the atypical ("Siboga") specimen of the latter species are conspecific. Other features of this same specimen are its dark greyish-brown colour, smooth surface and the tendency of the surface to be thrown into low folds.

The third Barrier Reef specimen is very like the type of *P. heteroraphis* in external form, but has the same colour as the preceding specimen, while the surface folds are more marked. The fourth specimen is the largest yet recorded for the species. It is subspherical, with apical oscule surrounded by a membranous collar, very dark in colour, with smooth surface thrown into pronounced folds or produced into foliate protuberances. So unlike the typical form is it that, but for the intermediates already discussed, it might be thought to represent a new species.

The variation in external form is accompanied by a variability in the size of the spicules, particularly of the large triradiates. Since this is often considerable, a comparative table is given below showing the extent of the variation in these spicules.

Specimen.	Length and diameter, at base, of typical ray of large triradiate.
P. heteroraphis, Poléjaeff. Holotype	2·0 × ·128.
P. heteroraphis, Poléjaeff. Dendy, 1916	1·55 × ·1.
P. peziza, Dendy. Holotype	1·4 × ·07.
P. heteroraphis, Poléjaeff. Burton, 1930:	
Specimen *a*	1·3 × ·13
,, *b*	·98 × ·075
,, *c*	1·1 × ·11
,, *d*	1·3 × ·13.
,, *e*	·48 × ·035.*
,, *f*	·5 × ·044.*
,, *g*	·96 × ·112.
P. heteroraphis. Barrier Reef:	
Specimen 1	1·44 × ·192.
,, 2	1·28 × ·096.
,, 3	1·28 × ·112.
,, 4	1·44 × ·096.

Distribution.—Malay area; Indian Ocean; Tristan da Cunha.

* Despite differences in the size of the spicules, these specimens are similar to others with more normal spiculation in all other respects.

Family Sycettidae.

Genus *Sycon*, Risso.

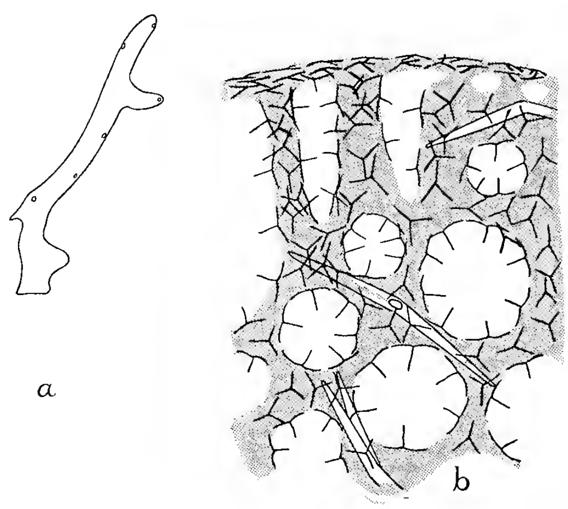
Sycon gelatinosum (Blainville).

Alcyoncellum gelatinosum, Blainville, 1834, p. 529, pl. xcii, fig. 5 ; Gray, 1867, p. 557 ; *Sycidium gelatinosum*, Haeckel, 1869, p. 245 ; *Grantia gelatinosa*, Bowerbank, 1869, p. 84 ; *Sycandra arborea* (= *Sycodrendron arboreum*), Haeckel, 1872, p. 331, pl. liii, fig. 1 ; pl. lviii, fig. 7 ; *S. alcyoncellum* (= *Sycothamnus alcyoncellum*) et varr. *gelatinosa, virgultosa*, Haeckel, *l. c.*, p. 333, pl. liii, fig. 2 ; pl. lviii, fig. 5 ; *Sycon gelatinosum*, Dendy, 1892, p. 83 ; Dendy and Row, 1913, p. 746 ; Dendy and Frederick, 1924, p. 483.

Occurrence.—Low Isles, 9th March, 1929.

Remarks.—A particularly robust colony, 3 cm. high.

Distribution.—Java ; Australia (east, south and west coasts).



Text-fig. 1.—*Leuconia ramosa*, sp. n., showing *a*, external form (× $\frac{2}{3}$), and *b*, the skeleton, from a section at right angles to surface.

Family Heteropiidae.

Genus *Leuconia*, Grant.

Leuconia ramosa, sp. n. (Text-fig. 1.)

Holotype.—B.M. 30.8.13.3.

Occurrence.—Stn. XXIV, 13th March, 1929 : $\frac{3}{4}$ mile N.E. of Pasco Reef, $16\frac{1}{2}$ fath., hard and shelly.

Diagnosis.—Sponge composed of cylindrical branches growing more or less erect, and tunnelled by numerous longitudinal canals ; surface smooth, even, minutely reticulate ; oscules, leading into shallow cloacae 1–3 mm. in diameter, situated at various points on branches ; colour, in spirit, pale greyish-brown ; dermal skeleton of regular triradiates, arranged tangentially, variable in size, each ray measuring up to ·22 × ·011 mm. ; skeleton of chamber layer confused, formed by small triradiates, slightly sagittal, with basal ray up to ·24 × ·012 mm., and large regular triradiates irregularly but sparsely distributed,

with rays measuring up to ·96 × ·064 mm. ; quadriradiates lining large canals of similar dimensions to small triradiates of chamber layer.

REMARKS.—The species is peculiar, among those species of *Leuconia* devoid of oxea, in its ramose form.

ORDER TETRAXONIDA.

Suborder HOMOSCLEROPHORA.

Family PLAKINIDAE.

Genus *Corticium*, Schmidt.

Corticium candelabrum, Schmidt.

C. candelabrum, Schmidt, 1862, p. 42, pl. iii, fig. 25 ; Lendenfeld. 1903, p. 122 ; Babić, 1922, p. 292.

OCCURRENCE.—Stn. X, 22nd January, 1929 : Satellite Reef, 14–17 fath., coral, shell, gravel, and mud.

DISTRIBUTION.—Malay Area ; Mediterranean.

Genus *Oscarella*, Schulze.

Oscarella tenuis, Hentschel.

O. tenuis, Hentschel, 1909, p. 351, pl. xxiii, figs. 9, 12.

OCCURRENCE.—Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., mud and rock.

REMARKS.—Incrustations on the Polyzoa *Microporella mutabilis*, Hastings.

DISTRIBUTION.—S.W. Australia.

Suborder ASTROSCLEROPHORA.

Family STELLETTIDAE.

Genus *Stelletta*, Schmidt.

Stelletta purpurea, Ridley.

S. purpurea, Ridley, 1884, p. 473, pl. xl, fig. E ; pl. xliii, fig. j ; Burton, 1926, p. 44 ; *idem*, 1930, p. 415.

OCCURRENCE.—Reef Crest, Yonge Reef, Outer Barrier, 5th June, 1929.

DISTRIBUTION.—Australia (north and east coasts) ; Malay Area ; Indian Ocean ; New Zealand ; Antarctic.

Stelletta clavosa, Ridley.

S. clavosa, Ridley, 1884, p. 474, pl. xliii, fig. i; Lendenfeld, 1906, p. 287; Hentschel, 1912, p. 310

Occurrence.—Stn. XVI, 9th March, 1929: About $\frac{1}{2}$ mile W. of N. Direction Is., 20 fath., stony. Stn. XIX, 10th March, 1929: $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell and gravel.

Distribution.—Australia (north and west coasts); Malay Area; Indian Ocean (from Ceylon eastwards).

Genus *Ancorina*, Schmidt.

Ancorina agglutinans, Thiele.

Ecionema agglutinans, Thiele, 1899, p. 7, pl. iv, fig. 1; pl. v, fig. 2.

Occurrence.—General Survey (no other information available).

Remarks.—The single specimen agrees closely with the holotype except that the microrhabds and asters are slightly larger, the asters being ·014 mm. in diameter as against ·01 mm. in the holotype.

Distribution.—Malay Area.

Genus *Jaspis*, Gray.

Jaspis stellifera (Carter).

(For synonymy and discussion see Shaw, 1927, p. 422.)

Occurrence.—Low Isles; the Thalamita Flat.

Distribution.—Australia (north and south coasts).

Family Chondrosiidae.

Genus *Chondrilla*, Schmidt.

Chondrilla nucula, Schmidt.

C. nucula, Schmidt, 1862, p. 39, pl. iii, fig. 22; Annandale, 1915, p. 470; Burton, 1924, p. 206; Dendy, 1924, p. 314.

Occurrence.—Low Isles; the Thalamita Flat, 4th April, 1929.

Distribution.—New Zealand; Australia (east and north coasts); Malay Area; Indian Ocean; West Indies; Azores; Mediterranean.

Chondrilla australiensis, Carter.

C. australiensis, Carter, 1873, p. 23, pl. i, figs. 10–14, 16; Burton, 1924, p. 207.

Occurrence.—Stn. XXIII, 12th March, 1929: In lee of Turtle Is., 8 fath., mud and shell.

Distribution.—Australia (east coast); Malay Area; Indian Ocean.

Suborder SIGMATOSCLEROPHORA.

Family Tetillidae.

Genus *Cinachyra*, Sollas.

Cinachyra, Sollas. 1886, p. 183 ; *Cinachyrella*, Wilson, 1925, p. 356.

Wilson (*loc. cit.*) proposed to subdivide those Tetillidae with porocalices into two subgenera, *Cinachyra* and *Cinachyrella*, having the same relation to each other as *Craniella* to *Tetilla*, the one having a stout cortical palisade of oxea, the other an ill-defined palisade or none at all ; but just as it is not possible, or necessary, to separate *Tetilla* and *Craniella*, so I believe it to be unnecessary and, probably, impossible to separate *Cinachyra* and *Cinachyrella*.

Cinachyra australiensis (Carter).*

Tethya cranium, var. *australiensis*, Carter, 1886, p. 127 ; *Tetilla ? australiensis*, Sollas, 1888, p. 43 ; *Spiretta raphidiophora*, Lendenfeld, 1888, p. 43 ; *S. porosa*, *idem*, *l. c.*, *p.* 43 ; *Cinachyra schulzei*, Keller, 1891, p. 337, pl. xix, figs. 41–43 ; *C. trochiformis*, *idem*. *l. c.*, p. 340, pl. xix, figs. 44, 45 ; *Tetilla ternatensis*, Kieschnick, 1896, p. 527 ; *T. schulzei*, *idem*, *l. c.*, p. 21 ; *idem*, 1900, p. 562, pl. xlv, figs. 16–22 ; *T. ternatensis*, Lindgren, 1898, p. 329, pl. xvii, fig. 14, pl. xix, fig. 25 ; *T. australiensis*, Thiele, 1899, p. 6, pl. i, fig. 1 ; pl. v, fig. 5 ; *T. ternatensis*, Kirkpatrick, 1900, p. 132 ; *Cinachyra malaccensis*, Sollas (Miss), 1902, p. 219, pl. xiv, fig. 2, pl. xv, fig. 5 ; *Tetilla lindgreni*, Lendenfeld, 1903, p. 18 ; *T. australiensis*, *idem*, *l. c.*, p. 20 ; *T. porosa*, *idem*, *l. c.*, p. 22 ; *T. poculifera*, Dendy, 1905, p. 90, pl. i, fig. 3, pl. vi, fig. 4 ; *Tethya hebes*, Lendenfeld, 1906, p. 98, pl. xvi, figs. 19–38 ; *Cinachyra isis*, *idem*, *l. c.*, p. 143, pl. xv, figs. 54–58 ; pl. xvi, figs. 1–4 ; *C. alba-tridens*, *idem*, *l. c.*, p. 149 ; pl. xv, figs. 7–9 ; *C. alba-bidens*, *idem*, *l. c.*, p. 151, pl. xvi, figs. 39–44 ; *C. alba-obtusa*, *idem*, *l. c.*, p. 154, pl. xvi, figs. 45–52 ; *Tetilla cinachyroides*, Hentschel, 1911, p. 281, fig. 1 ; *T. poculifera*, Row, 1911, p. 306 ; *Chrotella ibis*, Row, 1911, p. 311, pl. xxxv, fig. 2, pl. xxxvi, fig. 7 ; *Tethya clavigera*, Hentschel, 1912, p. 327, pl. xvi, fig. 1 ; pl. xviii, fig. 10 ; *Cinachyra mertoni*, *idem*, *l. c.* p. 332, pl. xiii, fig. 1 ; pl. xviii, fig. 12 ; *C. nuda*, *idem*, *l. c.*, p. 333, pl. xiii, fig. 2 ; pl. xviii, fig. 13 ; *C. vaccinata*, Dendy, 1921, p. 14 ; pl. i, fig. 4 ; pl. ii, fig. 1 ; *C. isis*, *idem*, *l. c.*, p. 16, pl. x, fig. 3 ; *C. providentiæ*, *idem*, *l. c.*, p. 18, pl. i, fig. 5, pl. x, fig. 2 ; *Tetilla* (*Cinachyrella*) *clavigera*, Wilson, 1925, p. 365, pl. xxxix, fig. 4 ; *T.* (*Cinachyrella*) *paterifera*, *idem*, *l. c.*, p. 375, pl. xxxix, figs. 6, 8 ; pl. xlviii, fig. 4.

Occurrence.—Low Isles ; the Thalamita Flat ; east of Sand Flat ; the Middle Moat ; the Mangrove Park ; Batt Reef.

Diagnosis.—Sponge more or less spherical, the outer surface usually coated with a layer of sand ; oscules small and inconspicuous, porocalices usually small and scattered over the surface ; skeleton composed of radial bundles of oxea which tend to spread out in divergent brushes at the surface ; anatriaenes or protriaenes may be present in small quantities. Microscleres, microxea, which may be sometimes absent, and sigmaspirae.

Remarks.—A large number of specimens of *Cinachyra* have been recorded from the Indo-Pacific under a variety of generic and specific names, but the majority of these are so much alike that a doubt arises as to the validity of these distinctions.

* Uliczka (1929, pp. 38–46) has recently described a group of species of *Cinachyra*, *C. rhizophyta*, *C. alloclada*, *C. apion*, *C. kükenthali*, *C. schistospiculosa*, from the West Indies which appear to be indistinguishable from *C. australiensis*. These have the same characters and range of variation as *C. australiensis*, as here understood, and there can be little doubt that they are synonyms of Carter's species.

The majority of the known individuals of *Cinachyra* from the Indo-Pacific may be divided into three groups, which may be called provisionally the *australiensis*-, *schulzei*- and *porosa*-groups respectively. The members of each of these are very similar in general characters and, after due allowance is made for the normal fluctuating variations in both the external form and in the details of spiculation, it is found that they may be distinguished in the following way only: the *australiensis*-group is characterized by the possession of roughened microxea; the *schulzei*-group has smooth microxea; and the *porosa*-group is without microxea. Before proceeding with the discussion of the taxonomic value of these particular characters, it will be necessary to consider in turn each of the three groups and the members of which it is composed.

The type of *Tethya cranium*, var. *australiensis*, Carter, from which the first group takes its name, is preserved in the dried state and is therefore in an unsatisfactory condition for examination. That it is a true *Cinachyra* is certain, but the porocalices, having collapsed on drying, have been mistaken for oscules. The skeleton consists of oxea, 5·0 by ·038 mm., anatriaenes, with cladi ·135 mm. long, roughened microxea, ·12 mm. long, and sigmaspirae, ·017 mm. chord. Complete protriaenes cannot be found in the preparations so far made, but there can be little doubt that they are, or were, present. The many slender rhabds terminating in a broken end a little beyond the surface almost certainly represent the shafts of the protriaenes, the cladi probably having been broken off by abrasion of the surface. The microxea, which are very abundant, were described by Sollas as "minutely-spined", but in effect their surfaces are only roughened, and to so slight a degree as to be barely perceptible.

Spiretta raphidiophora, Lendenfeld, is described as spherical and the dimensions of the spicules are practically identical with those of *Tethya cranium*, var. *australiensis*. The protriaenes cannot be found, and the microxea are faintly roughened and very abundant. Porocalices are present in the small fragment of the type preserved in the British Museum, but, as in the preceding specimen, their walls have collapsed so that the openings are inconspicuous. There can be no doubt therefore of the identity of this species with *Tethya cranium*, var. *australiensis*.

Tetilla australiensis (Carter), Thiele, bears clear indications of the presence of porocalices (see Thiele, 1899, pl. i, fig. 1) and the spiculation differs little from that of the holotype. The oxea are shorter, only 4·0 mm. long and antriaenes are absent. Protriaenes are present, with cladi ·15 mm. long. No doubt, as in the case of the protriaenes of the holotype, anatriaenes would be found if more careful search were made.

Tetilla schulzei, Kieschnick, an obvious *Cinachyra*, has a spiculation identical in all respects with that of *Tethya cranium*, var. *australiensis*, except that protriaenes, identical with those of *Tetilla australiensis* (Carter), Thiele, are present.

Tetilla ternatensis, Kieschnick, was inadequately described, but, even so, there is justification for regarding it as identical with *Tethya cranium*, var. *australiensis*, but the specimens described under the same name by Lindgren and Kirkpatrick, and re-named *Tetilla lindgreni* by Lendenfeld, are identical with *T. schulzei*, Kieschnick.

The type of *T. poculifera*, also an undoubted *Cinachyra*, differs slightly from the specimens already discussed in that the megascleres are all slightly smaller. There are present also some curious plagiotriaenes, but as these are absent in the co-types, which agree with the holotype in all other respects, they can only be regarded as teratological modifications of the normal protriaenes. The fact that the megascleres are slightly smaller does not

constitute a specific distinction and *T. poculifera* must take its place with the other specimens already discussed.

Tethya hebes, Lendenfeld, agrees almost exactly with *T. cranium*, var. *australiensis*, in external features, structure of skeleton and dimensions of spicules. It has, on the other hand, a few plagiotriaenes, such as are found in *Tetilla poculifera*.

Tetilla cinachyroides, Hentschel, was described from a fragment of sponge, but the original description shows that that piece had all the characters of *T. poculifera*, Dendy, except the porocalices, but these must almost certainly have been present on the missing portion of the sponge.

The great similarity between the specimens discussed above makes it impossible to regard them as representative of more than one species. Indeed, it is difficult to imagine why their identity with a single species should have escaped notice for so long a time.

The next group begins with *Cinachyra schulzei*, Keller. This appears to differ from the holotype of *Tetilla poculifera*, included in the *australiensis*-group, in the more conspicuous porocalices, in the presence of smooth microxea and microspheres, the latter being comparable with the silica-pearls of *Cinachyra barbata*, Sollas, enigmatic bodies having no taxonomic value. *C. trochiformis*, Keller, is very like *C. schulzei*, but differs in the absence of microspheres and in the distribution of the porocalices, which, instead of being generally distributed over the surface as in *C. schulzei*, are confined to a belt running round the lower part of the sponge.

C. isis, Lendenfeld, has the same form as *C. schulzei*, but its spicules are slightly larger, agreeing therein with those of *Tethya cranium*, var. *australiensis*. The plagiotriaenes are present, but not the microspheres. In fact, the only real difference between this species and *Tethya hebes* of the *australiensis*-group, rests in its having smooth, instead of roughened, microxea.

C. alba-tridens, Lendenfeld, agrees with the co-types of *T. poculifera*, except that the microxea are so rare that they readily escape detection. Lendenfeld makes no mention of the microxea, but in his preparations from the type they may be found in very small quantities.

Chrotella ibis, Row, is like *Cinachyra isis*, Lendenfeld, but differs in the presence of abnormal triaenes, and in having a comparatively smooth instead of a hirsute surface, which, as I have shown (Burton, 1931), is not unusual in such sponges and is probably due to a periodic extrusion of spicules.

Cinachyra mertoni, Hentschel, is almost identical with *C. alba-tridens*, Lendenfeld, while *C. nuda*, Hentschel, differs from both only in the absence of anatriaenes and in having a smooth surface as in *Chrotella ibis*, Row.

Of the two species of *Cinachyra* described by Dendy from the Indian Ocean, the first, *C. vaccinata*, is remarkable for its large porocalices,* and the second, *C. providentiae*, is practically indistinguishable from *C. alba-tridens*, Lendenfeld. Finally, *Tetilla paterifera*, Wilson, is obviously identical with *Cinachyra vaccinata*, Dendy, while the peculiar distribution of the porocalices in *C. trochiformis*, Keller, though interesting from other points of view, can have no taxonomic significance.

To summarize, the *schulzei*-group consists of a number of so-called species showing the same general characteristics and the same variations as the members of the

* At least, in the holotype, though in the paratypes the porocalices are more like those found in members of the *australiensis*-group.

australiensis-group. The only possible distinction that can be made between the *australiensis*-group and the *schulzei*-group lies therefore in the character of the microxea, whether they be rough or smooth, and to maintain a distinction on such grounds is out of the question. In the most roughened microxea of the *australiensis*-group, the roughening is only perceptible by careful examination with a high power of the microscope, and there can be no doubt at all that examination with sufficiently high magnification of a number of specimens would show all transitions from the rough to the smooth. Indeed, had not previous authors tended to stress this character, it would not have been considered worthy of more than passing mention here. There can be, then, no real distinction between the two groups, and their constituent species must all be considered synonymous with *Cinachyra australiensis* (Carter).

The identity with a single species of the many forms discussed above is more strikingly evident when the specimens are examined side by side than can be demonstrated by words and figures. The position of the *porosa*-group is, however, a matter of opinion. This group includes *Spiretta porosa*, Lendenfeld, *Cinachyra malaccensis*, Sollas, *C. alba-bidens*, Lendenfeld, *C. alba-obtusa*, Lendenfeld, and *Tethya clavigera*, Hentschel. Disregarding the minute details on which these various species were founded, we have here a group of sponges having the same essential characters as *C. australiensis* (Carter), as now understood ; the same globular or subglobular form, radial bundles of oxea diverging just below the surface to form dermal brushes of projecting oxea ; anatriaenes and protriaenes associated with radial bundles ; and the same sigmaspirae. But in no case have microxea been found. At the same time, mention has been made already of a specimen of *C. alba-tridens* in which, though present, these spicules were extremely rare, and there is no reason to suppose that other intermediates may not be found. There is, therefore, considerable justification for regarding the *porosa*-group as a collection of specimens of *C. australiensis* (Carter) which have lost their microxea.

Distribution.—Australia ; Malay Area ; Indian Ocean.

Genus *Raphidotethya*, gen. n.

Genotype.—*R. enigmatica*, sp. n.

Diagnosis.—Tetillidae with skeleton composed of well-defined fasciated systems of loose bundles of oxea radiating from a central nucleus ; distal ends of radial systems spreading out slightly near surface, with outermost spicules projecting beyond ; associated with distal ends of radial systems are smaller oxea set also at right angles to surface ; small oxea, similar to those found at surface, scattered sparsely in inner tissues ; triaenes absent ; cortex not recognizable ; microscleres sigmaspirae and raphides, each divided into two categories.

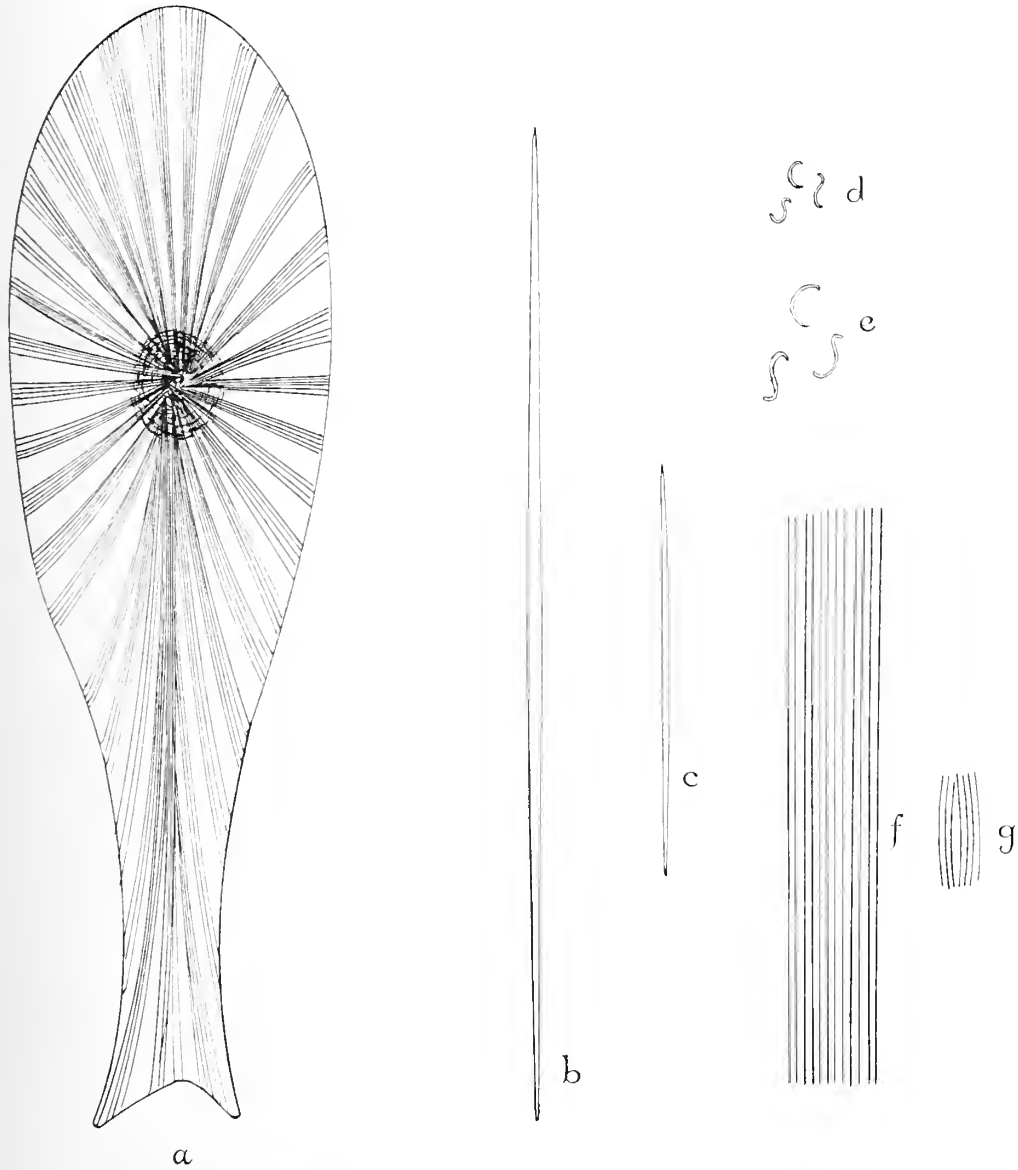
Remarks.—The genus is closely allied to *Amphitethya*, from which it differs mainly in the absence of triaenes.

Raphidotethya enigmatica, sp. n. (Text-fig. 2.)

Holotype.—B.M. 30.8.13.27.

Occurrence.—Stn. XVI, 9th March, 1929 : $\frac{1}{4}$ mile N. of N. Direction Is., 19 fath., sand.

Diagnosis.—Sponge ficiform, stipitate ; surface even, slightly hispid ; texture firm and fleshy ; oscules and pores not apparent ; oxea of main skeleton straight, smooth, measuring 1·4 by ·024 mm. ; smaller oxea, associated with distal ends of radial systems of main skeleton, straight and smooth, measuring ·73 by ·012 mm. ; sigmaspirae of two



Text-fig. 2.—*Raphidotethya enigmatica*, sp. n. *a*, Longitudinal section of whole sponge to show arrangement of main skeleton, × 2 ; *b* and *c*, large and small oxea, × 100 ; *d* and *e*, sigmaspiræ of two sizes, *f* and *g*, raphides of two sizes, × 300.

sizes, ·024 and ·009 mm. long respectively ; raphides, in bundles, of two sizes, ·03 and ·15 mm. long, respecitvely.

Remarks.—The holotype is $4\frac{1}{2}$ cm. high and 2 cm. in diameter at the widest point, just below the apex. Its shape recalls that of the species of *Amphitethya*, a closely-allied genus, in which the main skeleton has essentially the same structure, but which possesses amphitriaenes in addition to oxea. The sigmaspirae are of typical form.

Family Haploscleridae.

In dealing with the Haplosleridae of this report, special emphasis is laid on the utility of dermal skeleton as a guide to identification. In my experience the characters of the dermal skeleton, when present, and the presence or absence of a special dermal skeleton are features which have not been accorded their due significance. It is probable, judging from the preparations in the British Museum collections, that the common practice in identifying specimens is to cut two sections, one at right angles and the other tangentially to the surface, but it is quite certain that too little significance has been attached to the characters of the dermis as seen in tangential section. In the case of the Chalininae, we have two well-marked groups ; the first characterized by a soft texture and a pale-coloured spongin, and the second by a coarse, firm texture and dark-coloured spongin. Both the texture and the colour of the spongin are relative properties, transitions between the two groups in respect of these characters are often found, and well-marked exceptions to this generalization could be cited. Speaking generally the members of the first group are cosmopolitan, but more commonly found perhaps in temperate waters, the members of the second being almost exclusively confined to tropical or sub-tropical seas. But none of these features, texture, colour or distribution, is sufficiently constant to be used as a taxonomic guide. On the other hand, the first group is characterized by the complete absence of a special dermal skeleton (as in *Haliclona*) or by the presence of a tangential unispicular skeleton (as in *Adocia*). The second group is characterized by a stout dermal reticulation of spiculo-fibre (as in *Callyspongia*). In the character of the dermis we have then the only certain indication of a generic distinction.

In my preliminary examination of specimens of Haplosleridae I have often been misled by the appearance of tangential sections. For example, in a specimen of *Haliclona*, if the secondary fibres of the main skeleton lie just beneath the dermis, as they sometimes do, a tangential section will appear to contain a special dermal reticulation of the *Callyspongia*-type. In other cases, such as a specimen of *Callyspongia* with a feebly-developed dermal skeleton, the radial section gives the impression that a special dermal skeleton is absent. I have, therefore, found it necessary, in some cases, to examine the surface of a specimen first with a hand-lens, then with a low-power binocular microscope, and finally by means of a mounted tangential section. By using these three magnifications it is practically impossible to go wrong. Another very good criterion, but one which comes of experience, is the feel of the knife-edge as the section is cut, and the appearance of the surface after the cut is made. In fact, with a little experience, it is possible to forecast correctly in about 95 per cent. of the specimens examined from the mere act of cutting the tangential section.

I believe that the only hope of classifying the Haplosleridae satisfactorily is to pay as much, if not more, attention to the dermal skeleton as to the main skeleton. And I believe further that similar treatment applied to other groups will prove a great help. For example, the genus *Topsentia* contains a number of species the spiculation of which is made up of oxea of various sizes ; to that extent they all appear congeneric and to form a natural group. But it is certain that they represent several genera, since the disposition of these spicules differs considerably particularly in the dermis, and I have found from experience that it is practically impossible to recognize or to distinguish between these species without first finding out the characters of the dermal skeleton.

Genus *Haliclona*, Grant.

Haliclona, Grant, 1841, p. 5 ; *Chalina*, Grant, 1861, p. 76 ; *Diplodemia*, Bowerbank, 1864, p. 201 ; *Prianos*, Gray, 1867, p. 520 ; *Philotia*, *idem*, *l. c.*, p. 522 ; *Gellius*, *idem*, *l. c.*, p. 538 ; *Orina*, *idem*, *l. c.*, p. 539 ; *Chalinula*, Keller, 1879, p. 318 ; *Acervochalina*, Ridley, 1884, p. 398 ; *Phylosiphonia*, Lendenfeld, 1887, p. 796 ; *Euchalinopsis*, *idem*, *l. c.*, p. 815 ; *Chalinodendron*, *idem*, *l. c.*, p. 819 ; *Chalinorhaphis*, *idem*, *l. c.*, p. 821 ; *Polysiphonia*, Levinsen, 1887, p. 512.

Genotype.—*Spongia oculata*, Pallas, 1766, p. 390.

Diagnosis.—Haplosceleridae with skeleton composed of short oxea arranged typically in an isodictyal network of ascending primary fibres and short connecting secondary fibres ; fibres may be unispicular or multispicular, with spongin at ends of spicules only or forming a thick investment to whole spicular skeleton ; special dermal skeleton absent ; surface of sponge rendered hispid from projecting ends of primary fibres ; microscleres when present, sigmata, toxa or trichodragmata.

Remarks.—The genus *Haliclona* was first mentioned by Grant (1841, p. 5, fig. 2) in describing the anatomy and physiology of a species he called *Haliclona occulata* (*sic*). From his figure this sponge is clearly the *Spongia oculata* of Pallas, known since the days of Bowerbank as *Chalina oculata* (Pallas). *Haliclona* must therefore replace *Chalina*, a name first used by Grant (1861, p. 76), without diagnosis or genotype, and later adopted by Bowerbank (1864, p. 208) with *Halichondria oculata* (Pallas) Johnston as type. Of *Diplodemia*, Bowerbank (1864, p. 201), with genotype *D. vesicula*, Bowerbank (*loc. cit.* p. 202, figs. 234, 273, 377), it is impossible to say anything with certainty, but the probability is that the type comprises the remains of a *Haliclona* sp., possibly *H. oculata* (Pallas), left on a shell after the main mass of the sponge had been torn away. The genus *Philotia*, Gray (1867, p. 522), has for genotype *Isodictya varians*, Bowerbank (1864, p. 278, fig. 309), the holotype of which is an obvious example of *Haliclona oculata* (Pallas). Finally, *Euchalinopsis*, Lendenfeld (1887, p. 815) must also be regarded as a synonym of *Haliclona*. Lendenfeld named no genotype and the first species mentioned by him is *Chalina oculata* (Pallas). This species is accordingly accepted here as the genolectotype of the genus.

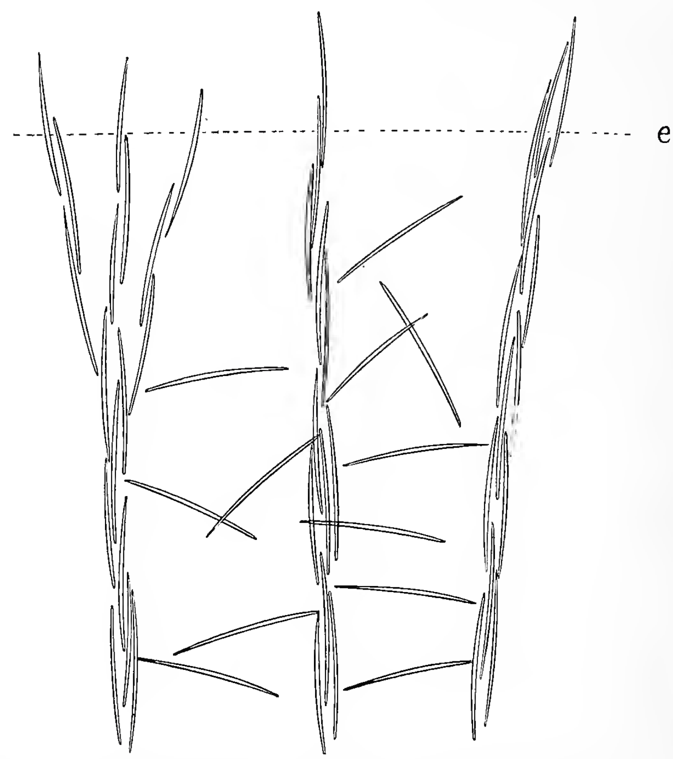
In addition to the genera so far discussed it is necessary to consider the relation of *Acervochalina* to *Haliclona*. *Acervochalina* was established by Ridley (1884, p. 398), for *Chalina limbata*, Bowerbank, with the following diagnosis :

" Massive, sessile Chalinidae. Fibre strongly ceratinous, containing axially or diffusely arranged slender acerate spicules, which do not exceed in bulk the horny material of the fibre which contains them. Vents distinct, ranged along upper surface."

According to this diagnosis the only essential difference between *Haliclona* and *Acervochalina* concerns the external form, which is wholly insufficient for a generic distinction, and since the structure of the skeleton differs hardly at all in the two cases, there is no reason for maintaining the distinction between the two genera. There is one other point that need be considered, if only because it offers a possible explanation of the reluctance on the part of some authors to abandon the use of the name *Acervochalina*. *Chalina limbata* is known to secrete quantities of mucilage in life and, as a consequence, presents a different appearance to *Haliclona oculata* and other typical species of *Haliclona*. The same may, however, be said of *Myxilla incrustans* as compared with other species of *Myxilla*, or *Tedania mucosa* and other species of *Tedania*. In fact, examples of this kind may be found in many genera. If we are to regard such secretion as a basis for generic distinction, then it will be necessary to subdivide very many other genera too on the same

grounds. To do so would, however, be little less than ludicrous. *Acervochalina* must, therefore, be regarded as a synonym of *Haliclona*, and with it *Chalinodendron*, Lendenfeld (*loc. cit.*, p. 819), with genolectotype *Chalina gracilenta*, Bowerbank (1866, p. 372), (= *C. limbata*, Bowerbank).

So far *Haliclona* (= *Chalina*, Auctt.) has been used to include only those species without microscleres, but there is no reason why species, with sigmata, toxa or trichodragmata, provided they agree in other respects, should not be included. The liability on the part of sponges to undergo reduction in the matter of microscleres is sufficiently well-known to call for much comment here, except to point out that greater convenience will result by extending the diagnosis of *Haliclona* to include all species with a chalinoid



Text-fig. 3.—*Gellius jugosus* (Bowerbank). Section at right angles to surface, to show arrangement of skeleton. From holotype. *e* = ectosome.

skeleton irrespective of the presence or absence of sigmata, toxa or trichodragmata. In this case, it will be necessary to include the genus *Gellius*, Gray (1867, p. 538), since the genotype, *Isodictya jugosa*, Bowerbank (1866, p. 296), has a typically chalinoid skeleton but, in addition, microscleres in the form of sigmata (see Text-fig. 3).*

---

* Genus *Gellius*, Gray, 1867, p. 538.

Genotype.—*Isodictya jugosa*, Bowerbank.

Genoholotype.—B.M. 10.1.1.294 (for description and illustration see Bowerbank, 1866, p. 296, 1874, pl. i, figs. 11–14).

Diagnosis.—Haplosceridae with sub-isodictyal skeleton of oxea, with multispicular ascending fibres joined at intervals by irregularly scattered single spicules ; distal ends of ascending fibres projecting slightly beyond ectosome ; no special dermal skeleton ; microscleres, when present, sigmata.

Discussion.—The holotype is a small incrustation on a calcareous nodule, and is preserved in the dried state, which makes the determination of its spicular characters difficult. It seems certain, however,

The genus *Phylosiphonia*. Lendenfeld (1887, p. 796), was established for *Chalinula fertilis*, Keller (1879, p. 318), and this species is here accepted as the genotype. According to Keller's description and figures, this is a typical *Haliclona*, but without examination of the type-specimen this cannot be stated definitely. The fact remains, however, that a specimen in the British Museum collection, obtained by Norman from the type-locality and agreeing closely with Keller's description of *Chalinula fertilis*, is quite definitely a *Haliclona*.

From a specimen of *Polysiphonia mucronata*, Levinsen, in the British Museum, presumably one of the co-types, it is clear that the species is a typical *Haliclona*.

Haliclona camerata (Ridley).

Reniera camerata, Ridley, 1884, p. 605, pl. liii, fig. H; pl. liv, fig. n; Topsent, 1897, p. 474; Dendy, 1921, p. 31.

Occurrence.—Low Isles, the Thalamita Flat, 20th April, 1929.

Remarks.—The first specimen, though possessing the external form typical of the species, differs slightly from the specimens hitherto recorded in the structure of its skeleton. This is a unispicular reticulation of triangular mesh, in which the component oxea measure ·16 by ·005 mm. In the holotype the oxea are ·2 mm. long and the skeleton an irregularly polygonal network of loosely-knit, multispicular fibres. The specimen described by Dendy (*loc. cit.*) has oxea measuring ·22 mm. long arranged in an irregular reticulation of unispicular and triangular mesh. There is yet another specimen in the British Museum, B.M. 27.2.14.8, with skeleton similar to that of Dendy's specimen, but having oxea measuring ·32 by ·02 mm., and this corresponds closely in spiculation with the second Barrier Reef specimen in which the oxea are ·28 by ·008 mm.

The series of specimens discussed above has a special significance. The external form is so characteristic that there can be no possibility of mistaken identity and we can be sure, therefore, as is so seldom the case in the genus *Haliclona*, that all the specimens so far assigned to the species are conspecific. Yet in these specimens the oxea vary from ·16 to ·32 mm. long and ·005 to ·02 mm. thick, and the skeleton itself varies from unispicular to multispicular with triangular or polygonal meshes. The data thus afforded are of great importance in the biometrical study of the spicules of the Chalininae.

Distribution.—Malay Area; Indian Ocean.

Haliclona reticulata (Lendenfeld). (Plate I, fig. 14.)

Euchalinopsis reticulata, Lendenfeld, 1887, p. 815.

Occurrence.—Stn. XIX, 10th March, 1929: $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell gravel.

Remarks.—The single specimen, which seems to resemble the holotype, is a roughly spherical mass, 6 cm. in diameter, of anastomosing trabeculae which bear on their outer margins occasional aculeate processes (Plate I, fig. 14). The surface is finely hispid, and almost conulose in parts. The colour, in spirit, is a greyish yellow. The skeleton is

---

as the result of exhaustive examination, that the main skeleton is a sub-isodictyal reticulation such as is shown in Text-fig. 3, although this condition is not realized at every point of the surface. From this it is clear that *Gellius* embodies the characteristics of what has hitherto been regarded as the "*Reniera*"-type of skeleton, and is, apart from the presence of sigmata, identical with *Haliclona*.

an irregular reticulation of spongin fibres cored by spicules measuring ·12 by ·003 mm. The spicules are not markedly strongylote, and occasionally stylote or even oxeote. The dimensions of the fibres are very much the same as those given for the holotype.

The original description of this species is somewhat inadequate and the holotype appears to be lost, or, at least, not immediately available, but the external form is so peculiar for a species of Chalininae that there would appear to be little doubt as to the identification of this specimen with that described by Lendenfeld. So far as the skeleton is concerned there is little to choose between the present specimen of *Haliclona reticulata* and the holotype of *Chalina obtusispiculifera*, Dendy, from Ceylon, while *C. cymaeformis* (Lamarck), also from Ceylon, differs only in slight details of external form. Possibly these three species may eventually be regarded as synonymous.

Distribution.—Australia (Port Jackson); Ceylon (?).

Haliclona clathrata (Dendy).

Reniera clathrata, Dendy, 1895, p. 237; *R.* spec. 6 Sollas (Miss), 1902, p. 211; *R.* spec. 4 Hentschel, 1912 p. 410; *R. clathrata*, Brøndsted, 1923, p. 125.

Occurrence.—Low Isles, Luana Creek, Luana Harbour.

Remarks.—The single specimen is very fragmentary and macerated, but appears at one time to have comprised a sponge of similar form to the holotype of *Reniera clathrata*, Dendy. In places it is massively encrusting, with oscules 3 to 4 mm. in diameter. In other places long slender processes, cylindrical in form, are given off, which may anastomose and bear, at intervals, curious tubular outgrowths, probably corresponding to similar processes in *Reniera* spec. 4 of Hentschel and referred to by that author as resembling "Schneckenfühler". The skeleton is a unispicular mesh, mainly triangular, through which short polyspicular fibres run at intervals. These fibres appear to be quite independent of the rest of the skeleton. The spicules are oxea measuring ·12 by ·005 mm.

The present specimen appears to be, so far as may be judged by the written descriptions, identical with Hentschel's *Reniera* spec. 4, and Sollas' *R.* spec. 6. It agrees, on the other hand, with the holotype of *Reniera clathrata*, Dendy, with which a direct comparison has been possible, in all respects but the size of the spicules and the unispicular character of the main skeleton. In that specimen the meshes of the main skeleton are mainly polygonal and bispicular, while the independent polyspicular bundles, though present, are feebly developed. In Brøndsted's specimen of *R. clathrata*, Dendy, from Campbell Is., which I have been able to compare with the holotype, the polyspicular bundles are wholly absent. For the rest there is very close agreement between the two in all respects. From such evidence as this it appears to be a debatable question how far the presence of independent polyspicular bundles may constitute an acceptable basis for specific distinction.

Distribution.—Australia (south coast); New Zealand; Malay Area.

Haliclona exigua (Kirkpatrick).

Petrosia exigua, Kirkpatrick, 1900, p. 139, pl. xii, fig. 7; pl. xiii, fig. 4.

Occurrence.—Batt Reef (or Low Isles ?); Three Isles.

Remarks.—The two specimens are typical except that the oxea measure ·16 by ·008

mm. in the first, and ·14 by ·007 mm. in the second, while those of the holotype measure ·114 by ·006 mm. A fourth specimen in the British Museum, B.M. 27.2.14.136, collected by Kirkpatrick from the reef off Christmas Island at low tide, has spicules measuring ·093 by 0·003 mm. In all but the holotype, which is a pale yellowish-white, the colour of the sponge is dark brown in spirit.

The characteristic features of the species are: (*a*) The surface is thrown into folds, producing irregular ridges and lobose processes; (*b*) the colour, in spirit, is usually dark brown; (*c*) the surface, though appearing smooth to the naked eye, is minutely hispid; (*d*) the ectosome appears detachable to the naked eye, but is actually non-detachable; (*e*) the oxea range from ·093 to ·16 by ·003 to ·008 mm.

DISTRIBUTION.—Malay Area.

Haliclona pigmentifera (Dendy).

Reniera pigmentifera Dendy, 1905, p. 143, pl. ix, fig. 10.

OCCURRENCE.—Low Isles, the Thalamita Flat.

REMARKS.—The single specimen forms an incrustation on a piece of coral rock. The colour, in spirit, is a dark purple-brown, but in life it was black. The surface is porose and the oscules 2 to 3 mm. in diameter with slightly raised margins. The skeleton does not appear to differ perceptibly from that of the holotype.

DISTRIBUTION.—Ceylon.

Haliclona tenuispiculata, sp. n.

Reniera semitubulosa, Dendy, 1921, p. 30; *Reniera* spec. 1, Hentschel, 1912, p. 409; nec *Spongia semitubulosa*, Lamarck.

HOLOTYPE.—B.M. 30.8.13.59.

OCCURRENCE.—Stn. XXII, 11th March, 1929: East of Snake Reef, 13½ fath., mud with foraminifera and shells; Low Isles, the Thalamita Flat.

DIAGNOSIS.—Sponge a mass of cylindrical branches, repent or erect (?); surface minutely hispid, porose; texture soft, friable; oscules 1–3 mm. in diameter, with tendency to linear arrangement along branches; skeleton irregularly sub-isodictyal, generally unispicular but becoming feebly multispicular in parts, with meshes triangular to quadratic; spicules oxea, slightly curved, ·144–·176 by ·004–·007 mm.

REMARKS.—The holotype, a fragment only, consists of three branches which, presumably, had grown in a recumbent position. In general it agrees very closely with the specimen identified by Dendy as *Reniera semitubulosa* (Lamarck), and more particularly with his R.N. LXVIII, 6. Hentschel's *Reniera* spec. 1, appears to be also a representative of the same species.

The characteristic features of the species are: The branching habit, the irregularity of the skeleton and the slender form of the spicules.

A small incrustation, in association with *Iotrochota purpurea* (Carter) and *Jaspis stellifera* (Carter) on a piece of coral rock, shows the typical anatomical details of the species.

DISTRIBUTION.—Malay Area; Indian Ocean.

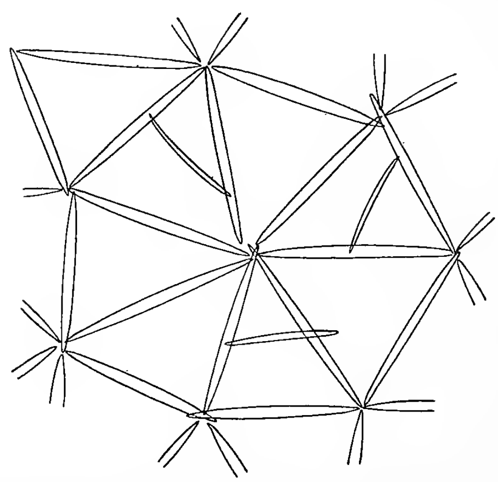
Haliclona flabello-digitatus, sp. n. (Plate I, fig. 10).

Holotype.—B.M. 30.18.13.167.

Occurrence.—Stn. XIII, 7th March, 1929 : ½ mile W. of Two Is., 16½ fath.

Diagnosis.—Sponge erect, irregularly flabello-digitate; surface even, minutely-hispid, porose ; oscules numerous, 3–6 mm. diameter, margins usually level with surface ; texture soft, compressible ; colour, in spirit, ash-grey ; skeleton an isodictyal reticulation of spiculo-fibre, becoming irregular in places, with primary fibres usually ·05 mm. and secondary fibres ·03 mm. thick, meshes of reticulation variable in size, ·2 to ·4 mm. across, and ranging from quadratic to irregularly polygonal; spicules oxea, straight or only slightly curved, ·15 by ·004 mm. ; primary fibres cored by oxea arranged in bi- or uniserial lines ; secondary fibres aspiculous or containing only uniserial lines of spicules ; surface hispid owing to feebly-developed tufts of spicules at distal ends of primary fibres ; microscleres absent.

Remarks.—This species bears a superficial resemblance to *Chalina montagui*, Bowerbank, but differs from it in the absence of a special dermal skeleton. It is probable that the specimen identified by Topsent as *C. montagui*, Bowerbank, from Amboina, may belong to this species.



Text-fig. 4.—*Adocia simulans* (Bowerbank). Portion of dermal skeleton. From holotype. × 200.

Genus *Adocia*, Gray. (Text-fig. 4.)

Adocia, Gray, 1867, p. 522 ; *Orina*, *idem*, *l. c.*, p. 539 ; *Siphonochalina*, Schmidt, 1868, p. 7 ; *Amorphina*, *idem*, 1870, p. 40 ; *Pellina*, *idem*, *l. c.*, p. 41 ; *Tubulodigitus*, Carter, 1881, p. 367 ; *Chalinopora*, Lendenfeld, 1887, p. 764 ; *Pellinella*, Thiele, 1905, p. 471.

Genotype.—*Chalina simulans*, Bowerbank, 1864, p. 101, pl. xix, fig. 299.

Genoholotype.—B.M. 32.1.5.2 (for description and illustration see Bowerbank, 1866, p. 308, 1874, pl. li, figs. 5–6).

Diagnosis.—Haploscleridae with a sub-isodictyal skeleton of oxea, with multispicular ascending fibres joined by irregularly-disposed isolated spicules ; special dermal skeleton, a tangential unispicular reticulation of triangular mesh with which small oxea may be associated ; microscleres, when present, sigmata and toxa.

Remarks.—The true characters of *Adocia simulans* have long been obscured and it

becomes obvious, now that the nature of the dermal skeleton is determined, that *Pellina*, with genotype *Halichondria semitubulosa*, Lieberkühn (= *Reniera** *semitubulosa*, Schmidt =*Pellina semitubulosa*, Topsent (1925, p. 709)), is a synonym of *Adocia*. *Halichondria angulata*, Bowerbank, the genotype of *Orina*, Gray (*loc. cit.*), has a similar skeleton to that of *Adocia*, but is without microxea in the dermal skeleton and has sigmata and toxa for microscleres. The absence of microxea from the dermal skeleton has little significance, since in undoubted specimens of *Pellina semitubulosa* these spicules vary considerably in number and are often so rare as to be virtually absent.

If we accept the absence of microxea from the dermal skeleton as a point without taxonomic significance, it will be necessary to include two other genera, *Siphonochalina* and *Pellinella*, as synonyms of *Adocia*. *Siphonochalina*, Schmidt, with genotype *S. coriacea*, Schmidt (1868, p. 7, pl. ii, fig. 4), was inadequately described and has been used to include all tubular Haplosceridae without microscleres. This practice, though convenient, is unscientific and has made the genus a heterogeneous collection of species. All that remains of the original specimen described by Schmidt is, so far as is known, a hand section (B.M. 68.3.2.13) in the British Museum collection labelled in Schmidt's handwriting. This is, therefore, accepted here as the holotype. According to this, the spicular characters of *S. coriacea* are precisely those of *Adocia simulans*, except that the microxea are absent.

Acervochalina claviformis, Carter, here chosen as genotype of *Chalinopora*, Lendenfeld, being the first species assigned to that genus, is a typical *Adocia*.

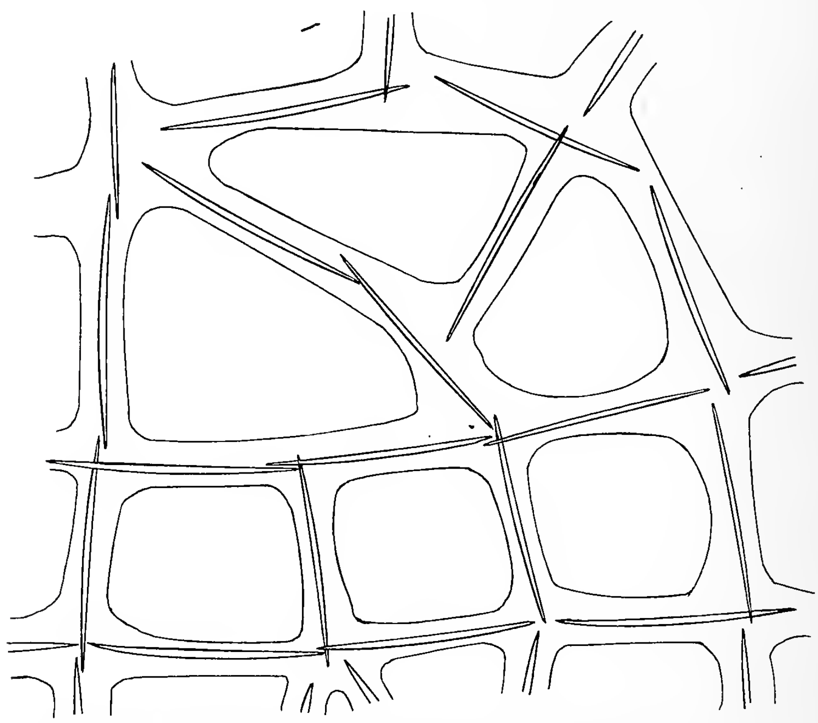
* The Genus *Reniera*, Nardo. Nardo (1833, p. 519) established the genus *Rayneria*, giving a brief and inadequate diagnosis, and referring to it a number of species (without diagnosis) of which the first-named was *R. typus*. Later (1847, p. 3), the same author referred to a genus *Reniera*, which, we may infer, was the same thing as *Rayneria*, the difference between the two names being due, presumably, to some question of correctness of spelling. At all events, Nardo, in speaking of *Reniera*, refers to *R. typica* (=*Rayneria typus ?*) as " Il tipo del genere ". Since no information is given in Nardo's works, or from those of Schmidt (who often redescribed Nardo's species, we have reason to believe, from the original specimens), both *Rayneria typus* and *Reniera typica* are *nomina nuda*. Vosmaer (1887, p. 339), stated, after referring to the genus *Rayneria*, that " Oscar Schmidt hat dann das Genus in *Reniera* umgeändert und sagt dass die Gattung ungefähr in dem Umfange und mit den Attributen, welche Nardo ihr beilegt, beibehalten werden müsse ". To attribute the name *Reniera* to Schmidt is wrong, and this has probably caused many to accept Schmidt's diagnosis of it. And to attempt to retain the genus on the characters " welche Nardo ihr beilegt " is hopeless ! The generic name *Reniera* must therefore be abandoned.

In the absence of any exact knowledge of the genus *Reniera*, but clinging to the use of the name with a quite inexplicable tenacity, authors from Schmidt's time to the present day have attributed to it certain characteristics which, as far as may be judged from their writings, are found in *Reniera cinerea* (Grant). This species was first mentioned by Grant (1826, p. 204), without description, under the name *Spongia cinerea*, was again mentioned by Fleming (1828, p. 521) without adequate description, and was first described with anything like completeness by Johnston (1842, p. 111), under *Halichondria cinerea*. Later Bowerbank, (1874, p. 121) redescribed the species, under *Isodictya cinerea*. The specimens used for these descriptions are lost, with the exception of those of Bowerbank, so that it is impossible to say what Grant understood by *Spongia cinerea*, especially in view of the fact that the types of *Chalina montagui*, Bowerbank, and *Isodictya cinerea*, Bowerbank, which are now known to be generically distinct, are practically undistinguishable externally.* I therefore accept Bowerbank's specimen (1874, pl. xlviii, fig. 1) of *Isodictya cinerea* as the neotype of *Spongia cinerea*, Grant, and since this is identical with his specimen of *Isodictya simulans* which I propose to make the neotype of *Halichondria simulans*, Johnston (nominated by Gray (1867, p. 522) the type of the genus *Adocia*), the species must be known henceforth as *Adocia cinerea* (Grant).

* When writing my paper of 1926, I used Bowerbank's original preparations. Since then, I have found that these are somewhat mixed, a slide not always belonging to the specimen from which it is alleged to have been made. In that paper, therefore, although the fundamental principles still hold good, some of the details have to be revised.

Pellinella, Thiele, with genotype *P. conica*, Thiele (1905, p. 471, figs. 90, 103), has exactly the same spiculation as *Siphonochalina*. The holotype is in the Berlin Museum, but a fragment of it is in the British Museum. According to Thiele (*loc. cit.*) the dermal skeleton in *Pellinella conica* is an irregular reticulation of loose oxea, but in the preparations made from the piece in the British Museum this is not the case, the dermal skeleton being here a regular reticulation of triangular mesh, exactly as in *Adocia simulans*.

Amorphina also appears to be a synonym of *Adocia*. This genus, established by Schmidt (1870, p. 40), was originally intended to include *Halichondria panicea* (Pallas) and a number of new species, and *H. panicea* should, strictly speaking, by its inclusion, have been chosen as genotype. Topsent (1925, p. 711) has, however, declared *Reniera grossa*, Schmidt, to be the type and this is accepted here. According to that author's



TEXT-FIG. 5.—*Tubulodigitus communis*, Carter, showing dermal skeleton. From neotype. × 200.

description of *R. grossa* the dermal skeleton appears to be the same as that found in *Adocia*, and *Amorphina* is therefore here regarded as synonymous with Gray's genus.

The genus *Tubulodigitus* was established by Carter (1881, p. 367) for a sponge collected in the Gulf of Manaar, which he called *T. communis*. This specimen cannot be found in the collections of the Liverpool Free Museum or the British Museum. I therefore take Dendy's specimen (B.M. 89.1.21.1), also collected in the Gulf of Manaar, as the neotype of the species. This is a tubular sponge with a regularly isodictyal main skeleton, in which the ascending fibres are bi- or trispicular and the conjunctive fibres unispicular, and a dermal skeleton composed of an irregular reticulation, with meshes varying from triangular to polygonal, but in no way divisible into primary or secondary meshes. The spicules are oxea measuring ·14 by ·004 mm.

The characters of *Tubulodigitus* are, therefore, essentially those of *Adocia* except that the spicules are completely enclosed in spongin (*cf.* Text-figs. 4 and 5). I have been

able to show, however, and hope to publish the observations soon, that within the species *Adocia simulans* all transitions occur between the skeletons described and figured here for *Adocia* on the one hand, and *Tubulodigitus* on the other. It will be necessary, therefore, to enlarge our conception of *Adocia* to include also those sponges of which *Tubulodigitus communis*, Carter, is representative.

Adocia toxius (Topsent).

Gellius toxius, Topsent, 1897, p. 470; Hentschel, 1912, p. 391; Dendy, 1921, p. 28.

Occurrence.—Low Isles. Crab Spit, 5th April, 1929; R.P. 2, south-eastern end of Mangrove Swamp: black sponge growing on Mangrove roots, 22nd March, 1929.

Remarks.—The numerous specimens are all of one type. They are erect, tubular sponges, dark brown in colour when preserved in spirit, black in life, with spiculation identical with that of the holotype.

Distribution.—Malay Area; Indian Ocean.

Adocia minor (Dendy).

Siphonochalina minor, Dendy, 1916, p. 115, pl. ii, fig. 15.

Occurrence.—Low Isles. Mangrove Park.

Remarks.—The structure of the skeleton in this species agrees with that of *Adocia simulans* (Bowerbank) in all respects but the absence of sigmata.

Distribution.—West coast of India.

Adocia obtusa (Hentschel).

Gelliodes obtusa, Hentschel, 1912, p. 394, pl. xiv, fig. 6; pl. xvi, fig. 2; pl. xxi, fig. 48.

Occurrence.—Stn. XIX, 10th March, 1929: $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell gravel. Stn. XXII, 11th March, 1929: $\frac{1}{2}$ mile N.W. of Howick Is., 10 fath., mud and shell.

Remarks.—Five specimens were obtained, all identical in external form and spiculation and agreeing in these respects with the holotype of the species, except that the oxea measure ·26 by ·006 mm. and the sigmata are absent.

Distribution.—Malay Area.

Adocia pumila (Lendenfeld). (Plate I, figs. 1–7.)

Gellius fibulatus (pars), Ridley, 1884, p. 425; *Siphonochalina pumila*, Lendenfeld, 1887, p. 806; *Gelliodes spinosella*, Thiele, 1899, p. 22, pl. ii, fig. 10; pl. v, fig. 17; *G. porosa*, Thiele, 1903, p. 943; *Gellius ridleyi*, Hentschel, 1912, p. 389 (nec *Gellius fibulatus*, Schmidt, *G. fibulatus*, Dendy, 1905, or *G. ridleyi*, Dendy, 1921).

Occurrence.—Low Isles; between Madrepore Moat and Mangrove Park; Mangrove Park.

Remarks.—The holotype of *Siphonochalina pumila*, Lendenfeld, now in the British Museum, has for main skeleton an isodictyal reticulation of spiculo-fibre, a tangential unispicular skeleton of triangular mesh, with oxea, measuring ·18 by ·008 mm., for megascleres and sigmata, measuring ·024 mm., for microscleres. It is, therefore, a typical *Adocia*.

The main skeleton is chiefly composed of spongin fibres cored by oxea, the primary fibres being multispicular and the secondaries usually uni- or bispicular, but immediately beneath the surface, to a depth of ·2 mm., the skeleton is devoid of spongin. This outer, non-fibrous zone of the main skeleton is probably the most distinctive feature of the whole skeleton. The sponge consists of a system of stout anastomosing branches with large oscules set in series on the upper surfaces and with conulose surface (Plate I, fig. 5).

All the Barrier Reef specimens have the typical skeleton structure and differ but slightly from the holotype in external form (Plate I, figs. 1–4, 6–7).

Both *Gelliodes spinosella*, Thiele, and *G. porosa*, Thiele, judging from the original descriptions, are identical with some of the examples of this species and must be considered synonymous with it, and *Gellius ridleyi* which I have examined, through the kindness of Dr. Max Thiel of the Zoologisch Museum at Hamburg, is certainly the same thing as *Siphonochalina pumila*.

A specimen from Kurrachee described by Ridley (*loc. cit.*) as *Gellius fibulatus* (Schmidt) also belongs to the species.

DISTRIBUTION.—Australia (north coast) ; Malay Area ; Indian Ocean.

Adocia sagittaria (Sollas).

Gellius sagittarius, Sollas, 1902, p. 212, pl. xv, fig. 7 ; *G. angulatus*, var. *canaliculata*, Dendy, 1905, p. 136, pl. ix, fig. 7.

OCCURRENCE.—Low Isles, east of the Sand Flat and the Thalamita Flat.

REMARKS.—In no single case has a complete specimen of this species been collected, but from the numerous fragments at my disposal it is possible to show that the external form consists of an irregular basal mass bearing a number of fistulae, some of which end in a crown of short filaments, while others end blindly. In all cases the spicules are oxea, sigmata and toxa. The fistulae are very fragile and readily broken off, so that in preserved specimens only in exceptional cases do we find any considerable length of a fistule attached to the body.

The types of this species were described as "consisting of a more dense basal part and of numerous slender tubes arising from this. In one specimen these tubes anastomose ; in the second they are broken off and show no indication of how they were arranged". The measurements of the spicules given were : Oxea, ·3–·35 by ·01–·013 mm. ; sigmata, ·012–·016 mm. chord ; and toxa, ·049 mm long. The outward form of the sponges was not figured. A few years later, Dendy (*loc. cit.*) described a sponge from Ceylon under the name *Gellius angulatus* (Bowerbank), var. *canaliculata*. This, too, was not figured, but the sub-spherical specimen, now in the British Museum collection, clearly bore in life a number of fistulae which were subsequently broken off and lost. The remains of these were described by Dendy as "a group of vents". The spicules are : Oxea, ·25 by ·008 mm. ; sigmata, up to ·028 mm. chord ; and toxa, ·044 mm. long. A conspicuous feature of the specimen, to which Dendy calls attention, is the presence of ramifying exhalant canals lying "just beneath the surface and covered over only by a thin translucent membrane, which is easily rubbed off, leaving the canals as open grooves".

The Barrier Reef specimens are extremely fragmentary and can only be recognized by their spicules, and by comparison with a number of specimens from the "Siboga" collection, at present in the British Museum.

The colour, in life, of the Barrier Reef specimens is given as magenta and ultramarine.

Distribution.—Malay Area ; Indian Ocean.

Adocia fibulatus, var. *microsigma*, Dendy.

Gellius fibulatus, var. *microsigma*. Dendy, 1916, p. 107 ; 1921, p. 26.

Occurrence.—Mangrove Park : the Thalamita Flat ; Batt Reef and Low Isles.

Remarks.—There are several specimens growing in association with algae as yet unidentified.

Distribution.—Indian Ocean.

Genus *Petrosia*, Vosmaer.

Petrosia strongylata, Thiele.

P. strongylata, Thiele, 1903, p. 938, fig. 2.

Occurrence.—Stn. XXIV, 13th March, 1929 : $\frac{3}{4}$ mile N.E. of Pasco Reef, 16½ fath., foraminifera and coral fragments.

Remarks.—The first specimen is irregularly massive, approximately 7 cm. long by 3 cm. broad and 3 cm. high, and dark brown in colour. There is a definite tangential dermal skeleton, and the spicules are strongyla of two sizes, ·2 by ·008 and ·06 by ·004 mm., occasionally modified to oxea. In the second specimen the dermal skeleton is often ill-defined in places, but otherwise it agrees with the first, and both differ from the holotype only in the smaller size of the spicules.

Distribution.—Malay Area.

Genus *Callyspongia*, Duchassaing and Michelotti.

Genolectotype.—*C. fallax*, Duchassaing and Michelotti.

Tuba, Duchassaing and Michelotti, 1864, p. 44 (*nec* Fabricius) ; *Callyspongia*, *eidem*, *l. c.*, p. 57 ; *Cladochalina*, Schmidt, 1870, p. 35 ; *Patuloscula*, Carter, 1882, p. 365 ; *Toxochalina*, Ridley, 1884, p. 402 ; *Dactylochalina*, Lendenfeld, 1886, p. 570 (1 : sep. pag.) ; *Spinosella*, Vosmaer, 1887, p. 342 ; *Ceraochalina*, Lendenfeld, 1887, p. 778 ; *Siphonella*, Lendenfeld (*nec* Macquart, *nec* Hagenow), 1887, p. 808 ; *Euchalina*, *idem*, *l. c.*, p. 817.

Diagnosis.—Haplosceridae with main skeleton a reticulation of spongin fibres cored with oxea ; special dermal skeleton a network of similar fibres subdivided by secondary or even tertiary fibres ; microscleres toxa (and possibly sigmata).

Remarks.—It has been possible, through the kindness of Dr. M. W. de Laubenfels, to re-examine the type of *Callyspongia fallax*, here accepted as the genolectotype of *Callyspongia*, and to determine that this species is conspecific with *C. eschrittii*, Duchassaing and Michelotti, *Tuba scrobiculata*, Duchassaing and Michelotti, *Patuloscula procumbens*, Carter, and *Ceraochalina vanderhorsti*, Arndt. Although the types of these supposed species vary in shape from massive to ramose or even tubular, the similarity in the skeleton, and the fact that many intermediate forms occur, leave no doubt as to their identity. Another important point is that the three co-types of *Callyspongia eschrittii* all contain abundant toxa. The type of *Patuloscula procumbens* also contains a few, but none could be found in *Callyspongia fallax* or *Tuba scrobiculata*. It seems therefore that,

in regard to the variable occurrence of microscleres, *Callyspongia fallax,* in its wider sense, is comparable with *C. ramosa* (see p. 603). As regards the variation in external form the species is likewise comparable with *C. diffusa* (see p. 541).

The genus *Tuba,* Duchassaing and Michelotti, with lectotype *T. sororia,* is preoccupied for a Mollusc (Fabricius, 1823), but the lectotype is a *Callyspongia* closely related to *Tuba armigera,* Duchassaing and Michelotti, which was made the type of the genus *Cladochalina* by Schmidt (1870, p. 35). *C. armigera* differs from *Callyspongia fallax* mainly in the characters of the dermal skeleton ; in the former the primary meshes are subdivided into numerous small secondary and tertiary meshes ; in the latter there is no differentiation into secondary and tertiary meshes and the network is altogether more open than in *Cladochalina armigera.* The difference, which can be best appreciated by comparing Arndt, 1927, p. 155, fig. 16, and Dendy, 1890, pl. lviii, fig. 6, although fairly great, does not prove in practice to be one of generic importance. *Cladochalina* must therefore be regarded as a synonym of *Callyspongia.*

The genus *Patuloscula* must also be considered a synonym of *Callyspongia* since *Patuloscula procumbens* (= *Callyspongia fallax,* see above) is the genotype, and it is worth recording that the dermal skeleton in this species is often echinated, as in *Callyspongia diffusa* (see p. 542, Text-fig. 6).

Desmacidon folioides, Bowerbank, the genotype of *Toxochalina,* has a skeleton like that of *Cladochalina armigera* and has, in addition, toxa for microscleres ; but, as we have seen, these spicules may also be present in *Callyspongia fallax* (the genotype) and *C. ramosa* (a typical species of the genus *Callyspongia*). The only supposedly distinctive feature of *Toxochalina* is therefore lost and this genus also becomes a synonym of *Callyspongia.*

The genus *Spinosella,* Vosmaer (1887, p. 342), for *Tuba sororia,* Duchassaing and Michelotti, also becomes a synonym of *Callyspongia* since, as we have seen above, the genotype cannot be separated generically from *C. fallax.*

Finally, of the many generic names created by Lendenfeld in 1887, *Ceraochalina,* genolectotype *Cladochalina nuda,* Ridley, *Siphonella* (preoccupied Diptera, Macquart, 1835 ; Polyzoa, Hagenow, 1850), genolectotype *Siphonochalina fortis,* Ridley, and *Euchalina,* genolectotype *E. rigida,* must all be considered synonyms of *Callyspongia,* and to these must be added *Dactylochalina,* Lendenfeld, with genotype *D. australis.*

Callyspongia subarmigera (Ridley).

Cladochalina subarmigera, Ridley, 1884, p. 397, pl. xxxix, fig. H ; pl. xli, fig. L ; *Chalinopora subarmigera,* Lendenfeld, 1887, p. 767 ; *Chalina subarmigera,* Lindgren, 1897, p. 481 ; *idem,* 1898, p. 13.

Occurrence.—Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., rock and shell gravel.

Distribution.—Australia (north and east coasts) ; Malay Area.

Callyspongia fibrosa (Ridley and Dendy).

Dasychalina fibrosa, Ridley and Dendy, 1886, p. 330 ; *Pachychalina fibrosa,* Ridley and Dendy, 1887, p. 21, pl. iv, figs. 3–4 ; *Chalina spinifera,* Carter, 1889, p. 66, pl. v, figs. 1–2 ; *Pachychalina spinilamella,* Dendy, 1889, p. 80 ; *P. fibrosa,* Lindgren, 1897, p. 481 ; 1898, p. 11, pl. xix, fig. 6 ; Kirkpatrick, 1900, p. 356 ; *Pachychalina spinilamella,* Dendy, 1905, p. 149, pl. vii, fig. 8 ; *Pachychalina fibrosa,* Dragnewitsch, 1905, p. 26 ; Hentschel, 1912, p. 400 ; *Cladochalina spinilamella,* Burton, 1927, p. 511.

Occurrence.—Stn. XXIV, 13th March, 1929: $\frac{3}{4}$ mile N.E. of Pasco Reef, $16\frac{1}{2}$ fath., hard and shell bottom.

Remarks.—The specimen closely resembles that described by Carter under *Chalina spinifera.*

Pachychalina spinosissima, Dendy, is not, as Lindgren (1898) suggests, a synonym of this species. Although having a similar external form, the structure of its dermal skeleton suggests an affinity with *Dasychalina.*

Distribution.—Malay Area; Indian Ocean.

Callyspongia confoederata (Ridley).

Tuba confoederata, Ridley, 1884, p. 400; *Siphonella laxa* Lendenfeld, 1887, p. 803, pl. xxiv, fig. 55; *Siphonochalina confoederata, idem, l. c.*, p. 803, pl. xxv, fig. 60; *S. typica, idem, l. c.*, p. 804, pl. xxiv, fig. 54; pl. xxvii, figs. 2, 19; *S. elastica, idem, l. c.*, p. 805; *S. paucispina, idem, l. c.*, p. 805; *S. axialis, idem, l. c.*, p. 805, pl. xxiv, fig. 53; *S. extensa*, var. *dura, elegans, idem, l. c.*, p. 806; *Siphonella tuberculata, idem, l. c.*, p. 808; *Spinosella confoederata*, Topsent, 1897, p. 479, pl. xix, fig. 20.

Occurrence.—Stn. XII, 24th February, 1929: Penguin Channel, 10–$15\frac{1}{2}$ fath., rock and shell gravel. Stn. XVI, 9th March, 1929: $\frac{1}{2}$ mile W. of N. Direction Is., 20 fath., stony.

Remarks.—The numerous species included above as synonyms of *Callyspongia confoederata* (Ridley) are so obviously members of a single species that it is necessary to say little on this point. The British Museum collection contains the types of all Lendenfeld's species included above and from these it is clear that the structure of the main and dermal skeletons is identical in every case. Moreover, in external form they show no greater variety than those specimens recorded below under *C. diffusa.*

Here, again, is shown the inadequacy of any attempt to differentiate between tubular and non-tubular forms. One specimen, from the present collection, agreeing in structure with the rest, is irregularly massive and gives no sign of even an incipient tubular growth.

Distribution.—Australia (north, east and west coasts); Malay Area.

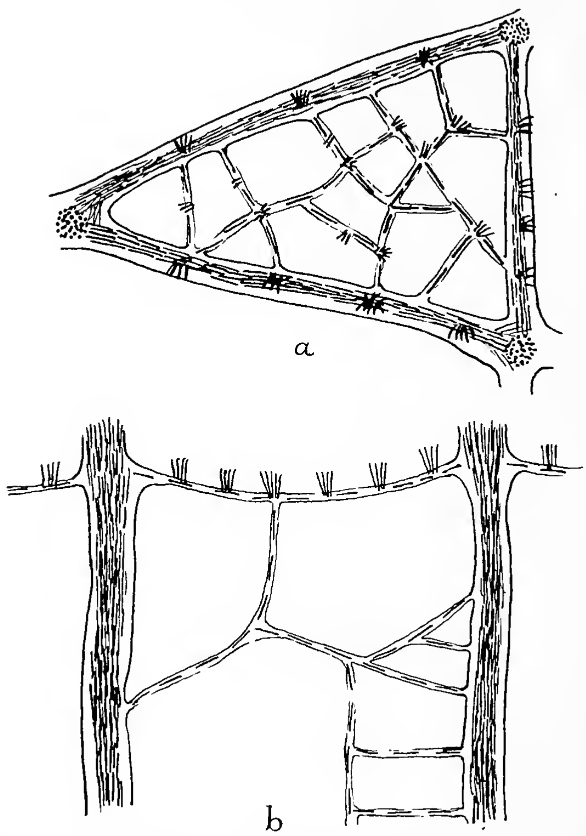
Callyspongia diffusa (Ridley). (Text-fig. 6.)

Acervochalina finitima (*pars*) Ridley, 1884, p. 399*; *Cladochalina diffusa*, Ridley, 1884, p. 672, pl. xli, fig. D; *idem*, 1884, p. 183; *Cladochalina elegans*, Lendenfeld, 1887, p. 770; *Chalinissa ramosa, idem, l. c.*, p. 774, pl. xx, fig. 31; *Ceraochalina multiformis*, var. *digitata* (pars: specimen from Port Jackson), *idem, l. c.*, p. 784, pl. xix, fig. 20; *Pachychalina multiformis*, var. *manaarensis*, Dendy, 1889, p. 79; *Siphonochalina crassifibra, idem, l. c.*, p. 82; *Chalina pulvinatus*, Lindgren, 1897, p. 481; *idem*, 1898, p. 13, pl. xviii, figs. 2, 16; pl. xix, fig. 7; *Ceraochalina retiarmata, idem*, 1905, p. 152, pl. x, fig. 4; *C. multiformis*, var. *manaarensis, idem, l. c.*, p. 154, pl. vii, fig. 3; pl. x, fig. 6; *Chalina palmata*, Dendy and Frederick, 1924, p. 499.

Occurrence.—Low Isles, Crab Spit and Mangrove Park. Stn. XIX, 10th March, 1929: About $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda.*

* Ridley (1884) identified 3 specimens with *Acervochalina finitima* (Schmidt). The correct systematic position of these is: Specimen 1 (B.M. 81.10.21.249–250) from Port Jackson = *Callyspongia diffusa*; specimen 2 (B.M. 87.10.21.367) from Percy Island, Queensland = *Haliclona* (*Chalina*) *minor* (Row); specimen 3 (B.M. 82.2.23.267–8) from Alert Island, Torres Straits = *Haliclona* sp. In addition, 2 specimens from the Seychelles were identified as *Acervochalina finitima* (Schmidt) var., and of these the first (B.M. 82.10.17.80–81) is identical with *Haliclona minor* (Row), and the second (B.M. 82.10.17.82) is a *Tubulodigitus* sp. (see Text-fig. 5).

REMARKS.—The type of *Cladochalina diffusa*, Ridley, is sub-ramose with flattened branches, sparingly spinose, with small oscules (2–3 mm. diameter), scattered over the surface. The main skeleton consists of an irregular network of stout polyspicular fibres, and the dermal skeleton consists of a network of stout fibres forming a mainly triangular mesh, subdivided by more slender fibres, the whole echinated at intervals by sparse tufts of spicules set out at right angles to the surface (Text-fig. 6*a*). The spicules are oxea measuring ·135 by ·006 mm. The dermal skeleton is particularly striking and serves better than anything else to characterize the species.



TEXT-FIG. 6.—*Callyspongia diffusa* (Ridley), showing *a*, dermal and *b*, main skeletons. × 50. [Although taken from the type of *Chalina pulvinatus*, Lindgren, this drawing represents the typical condition in *Callyspongia diffusa*.]

A precisely similar skeleton is found in the following species: *Ceroachalina multiformis*, varr. *digitata* et *manaarensis*, *C. retiarmata*, Dendy, *C. ceylonica*, Dendy, *Chalina palmata* (Lamarck), Dendy and Frederick, *C. pulvinatus*, Lindgren, *Chalinissa ramosa*, Lendenfeld, *Cladochalina elegans*, Lendenfeld, and *Siphonochalina crassifibra*, Dendy, and it remains to be seen how far these species may be considered identical.

The type of *Ceraochalina ceylonica*, Dendy, differs from that of *Cladochalina diffusa* in having a more markedly spinose surface, and in having fewer spicules in some of the fibres, particularly in the main skeleton. Apart from these differences there is nothing to distinguish the two. *Chalinissa ramosa*, Lendenfeld, from Port Jackson, and *Chalina palmata*, Dendy and Frederick, from Abrolhos Island, have the same branched form as *Cladochalina diffusa*, but are entirely without spines. In addition, there are fewer

spicules in the fibres, the fibres of the dermal skeleton usually containing only a uniserial line of spicules. *Chalinissa ramosa* and *Chalina palmata* are undoubtedly identical, and there is no good reason for separating them from *Cladochalina diffusa*.

The Port Jackson specimen of *Ceraochalina multiformis*, var. *digitata*, Lendenfeld, has slightly more spicules than *Chalinissa ramosa*, has a palmo-digitate external form and, apart from the absence of spines, cannot be distinguished from *Cladochalina diffusa*. *Ceraochalina multiformis*, var. *manaarensis*, Dendy (and this applies equally to the specimens from the Gulf of Manaar and from Abrolhos Is.), *C. retiarmata*, Dendy, and *Cladochalina elegans*, Lendenfeld, all have the same type of skeleton as *Chalinissa ramosa* and vary in form from the flabello-digitate, as in *Ceraochalina multiformis*, var. *digitata*, to flabellate.

The next group of species, including *Chalina elegans*, Lindgren, and *Siphonochalina crassifibra*, Dendy, comprises tubular specimens, having the same skeleton as *Cladochalina diffusa*.

The radical step of identifying this group of supposed species of markedly differing external form under one name needs good justification, for it is contrary to all ideas previously held on the classification of the Haplosceridae. But in the Barrier Reef collections we have a batch of specimens which show the following shapes: massive to massive with low tubular oscules; tubular and repent, the tubes anastomosing; erect and tubular; flabellate, with oscules arranged serially around the margin or scattered over one face; cylindrical and repent, with long slender branches. Further, the usually smooth surface may bear a varying number of spines; and their skeletons show the same variations as are met with in that group of "species" now combined under *Callyspongia diffusa*. A most important point is that all the Barrier Reef specimens, with one exception, were collected in the same locality and have the same texture and colour, and may be regarded with a fair degree of certainty as conspecific.

Distribution.—Australia (east and west coasts); Malay Area; Indian Ocean.

Callyspongia clathrata (Dendy).

Chalina clathrata, Dendy, 1905, p. 151, pl. x, fig. 3.

Occurrence.—Stn. XXV, 17th March, 1929: in Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Remarks.—A small encrusting specimen, with a single vent, on *Thorectopsamma irregularis*, sp. n.

Distribution.—Ceylon.

Callyspongia ridleyi, sp. n. (Text-fig. 7.)

Tuba bullata, Ridley, 1884, p. 399; *nec Spongia bullata*, Lamarck, and *Siphonochalina bullata*, Schmidt.

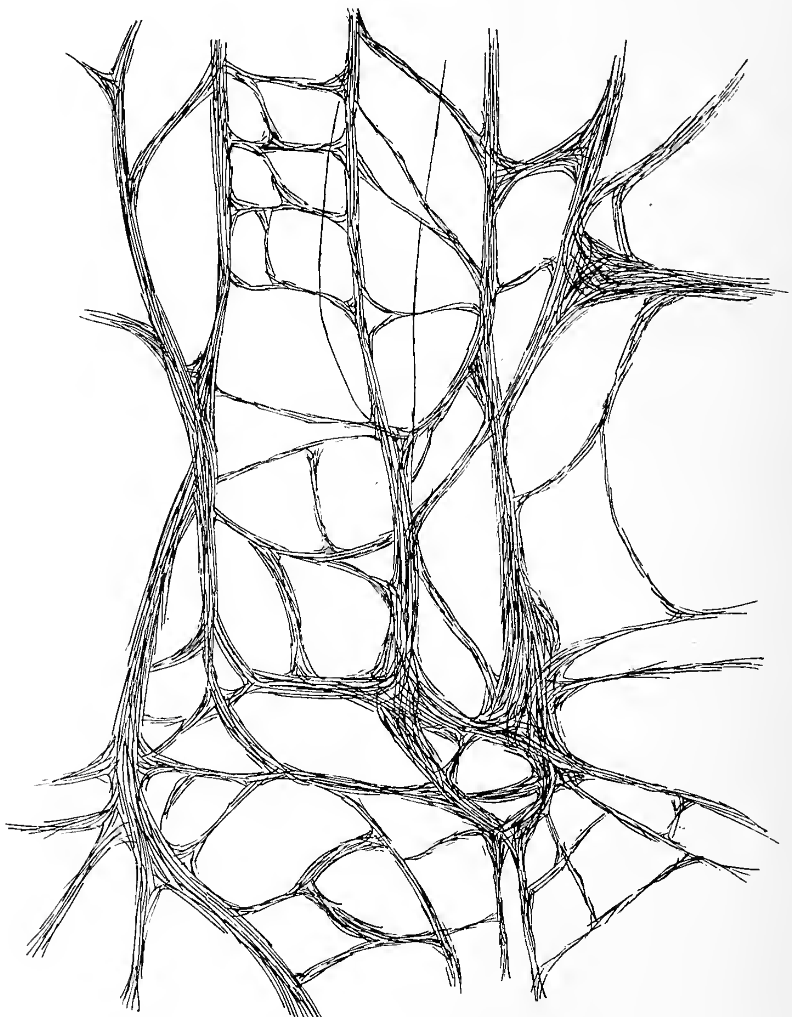
Holotype.—B.M. 81.10.21.249.

Occurrence.—Low Isles, 8 fath.

Remarks.—The single specimen consists of a large irregularly infundibuliform sponge with smaller lateral outgrowths. The latter are mostly tubular, but occasionally infundibuliform also. The whole colony measures 20 cm. in height and 30 cm. in extent either way. The outer surface is conulose throughout, and in places marked by irregular and

inconspicuous ridges. The colour, in the dried state, is brown, and the texture firm and incompressible.

The skeleton of both the present specimen and the holotype are closely similar. The main skeleton (Text-fig. 7*a*) consists of an irregular system of branching and anastomosing fibres, subdivided by more slender fibres. The thicker fibres run generally towards the surface. The dermal skeleton (Text-fig. 7*b*), though very similar, is quite distinct from it, and may readily be separated from its outermost fibres. It consists of an irregular



TEXT-FIG. 7*a*.—*Callyspongia ridleyi*, sp. n. Portion of main skeleton. × 26.

system of stout fibres which branch and anastomose without order, and the meshes formed by this system are subdivided by more slender fibres. In both main and dermal skeletons it is not possible to differentiate clearly between primary and secondary fibres, as is usually the case in the Chalininæ, since both are of varying thickness, and grade one into the other. Some of the slender (secondary ?) fibres, for example, are unispicular, others multispicular and as thick as the more slender of the (primary ?) fibres forming the main system.

The fibres almost invariably contain a fair quantity of spongin, and this is true even of the unispicular fibres, but the number of spicules contained is so numerous and arranged

so irregularly that the spongin itself is more or less masked by the spicules. The spicules are oxea measuring ·2 by ·008 mm. There is no sign of the " acuates " recorded by Ridley, and we may reasonably regard such as occur in the holotype as abnormal oxea.

Spongia bullata, Lamarck, with which Ridley believed his specimen to be identical, is an *Adocia* with a totally different arrangement of the skeleton.

DISTRIBUTION.—Port Molle and Port Curtis, Queensland.

TEXT-FIG. 7*b*.—*Callyspongia ridleyi*, sp. n. Portion of dermal skeleton. × 26.

Genus *Oceanapia*, Norman.

Oceanapia, Norman, 1869, p. 334 ; *Rhizochalina*, Schmidt, 1870, p. 35 ; *Phloeodictyon*, Carter, 1882, p. 122.

REMARKS.—There has been much uncertainty about the use of the three names, *Oceanapia*, *Rhizochalina* and *Phloeodictyon*, but it is fairly certain that we must regard them as synonyms. The external form and the structure of the skeleton is identical in each of these genera, but whereas *Oceanapia* possesses sigmata, the other two do not. *Rhizochalina* and *Phloeodictyon* must therefore be considered as synonyms without hesitation, and it merely remains to be determined whether the presence or absence of sigmata can be regarded as a basis for generic distinction, as has been done by most authors. Experience shows that the ease with which microscleres may be lost is far greater than is

ordinarily recognized. In the present instance we have examples of this, but the significance has usually been overlooked or wrongly interpreted. The holotype of *Rhizochalina*, *R. oleracea*, for example, has no sigmata, but *R. carotta* from the same locality, and clearly congeneric if not conspecific, has. Topsent (1920, pp. 5–6) recognizes from this that *Rhizochalina* may or may not possess sigmata, and this, in my opinion, is the only view possible, in which case there can be no distinction between that genus and *Oceanapia* and *Phloeodictyon*.

In this connection Dendy (1905, p. 166) found "that at one of the "Challenger" stations, specimens of *Phloeodictyon fistulosum* with and without sigmata appear to occur together, and are so closely similar in external appearance that they cannot be distinguished otherwise than microscopically". And on the strength of this Dendy united *Rhizochalina*, without sigmata, and *Oceanapia*, with sigmata, in one genus.

He seems then to have changed his mind and asserted that: "It seems equally reasonable, however, to suppose that the two genera (*i. e. Rhizochalina* and *Oceanapia*) actually occur together in this locality, or that there has been some confusion in the sorting out of the specimens". This seems to be clearly a case of taking a difficult detour to avoid an obvious truth.

Oceanapia fistulosa (Bowerbank).

(For synonymy see Dendy, 1905, p. 165.)

Occurrence.—Low Isles, S.E. of Mangrove Park. Stns. II and III, 24th November, 1928: Linden Bank, 28 fath., shell and sand.

Distribution.—Australia (west and north coasts); Malay Area; Indian Ocean; Azores (?); Bahia (?).

Oceanapia renieroides, sp. n.

Holotype.—B.M. 30.8.13.49.

Occurrence.—Low Isles, 28th March, 1929.

Diagnosis.—Sponge massive (or sub-spherical ?) with blind fistulæ; surface smooth; texture friable; colour, in spirit, white, main and tangential dermal skeletons of body a unispicular and triangular mesh; dermis of fistulae supported by tangential skeleton like that of body, with a sub-dermal multispicular reticulation of polygonal mesh; spicules oxea, measuring ·14 × ·005 mm.

Remarks.—Only a few fragments of the body and a fistule remain. The texture of the sponge is very unlike that of the usual *Oceanapia* species. This is because the skeleton is unispicular throughout. The species is most nearly related to *Phloeodictyon polysiphonia*, Dendy, from the Indian Ocean, but in that species the spicules of the main skeleton tend to be arranged in multispicular fibres.

Oceanapia elastica (Keller).

Reniera elastica, Keller, 1891, p. 306, pl. xvi, figs. 3, 7; *Petrosia elastica*, Lindgren, 1897, p. 480; *idem*, 1898, p. 5, pl. xviii, fig. 13; pl. xix, fig. 5.

Occurrence.—Stn. XVII, 9th March, 1929: $\frac{1}{4}$ mile N. of N. Direction Is., 19 fath., sand; Stn. XXXV, 17th March, 1929: in Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Remarks.—The holotype of *Reniera elastica*, Keller, appears to be nothing more than the fistule of a specimen of *Oceanapia*, and Lindgren's specimens, which I have been able to examine, certainly are. The first of the present specimens, consisting of a fistule 11 cm. long and encrusted with a species of Gorgonid, is identical with Lindgren's specimens and, there is little reason for doubt, with the holotype.

The second specimen consists of a sub-spherical body bearing on its upper surface the bases of a few small fistulae. That this belongs also to Keller's species, there can be no doubt, but since the general form of the sponge is similar to that of *Oceanapia fragilis*, Topsent, and the skeleton much the same except for the absence of sigmata, it is probable that Keller's species is identical with Topsent's *O. fragilis*.

Distribution.—Malay Area; Red Sea.

Family Desmacidonidae.

Section Isodictyeae.

Genus *Desmapsamma*, gen. n.

Genotype.—*Fibularia anchorata*, Carter, 1882, p. 283.

Diagnosis.—*Isodictyeae* with a special dermal skeleton of multispicular fibres forming an irregular reticulation of polygonal mesh; much sand incorporated in skeleton; spicules oxea, tridentate isochelae and sigmata.

Remarks.—*Fibularia anchorata*, Carter, was originally described from a specimen from Antigua, West Indies, and is identical with that described later by Ridley and Dendy from Bahia, as *Desmacidon reptans*. Lindgren, later still, recorded *D. reptans* from the Indo-Pacific. I have compared the types of *Fibularia anchorata* and *Desmacidon reptans* with Lindgren's specimen of *D. reptans*, those of the present collection, and several from the "Siboga" collection, which I had provisionally identified as *D. reptans*. As the result of this comparison, there can be no doubt that these specimens represent a single species distributed alike in the West Indian and the Indo-Australian regions.

Arndt (1927, p. 147) realizing the affinity of *Fibularia anchorata* Carter to the genus *Desmacidon*, referred it to that genus, and changed the specific name to *D. carterianum*. This he did under the impression that *Axos anchorata*, Carter, an earlier species, also belonged to *Desmacidon*. *Axos anchorata*, however, belongs to the genus *Plumocolumella*.

Desmapsamma anchorata (Carter).

Fibularia anchorata, Carter, 1882, p. 283; *Desmacidon reptans*, Ridley and Dendy, 1886, p. 345; *idem*, 1887, p. 105, pl. xxiii, fig. 7; Lindgren, 1897, p. 482; *idem*, 1898, p. 21; *D. carterianum*, Arndt, 1927, p. 147.

Occurrence.—Low Isles; the Thalamita Flat.

Distribution.—Malay Area; West Indies; Bahia.

Section Mycaleae.

Genus *Mycale*, Gray.

Mycale grandis, Gray.

Mycale grandis, Gray, 1867, p. 533; *M. armata*, Thiele, 1903, p. 950, fig. 16; *M. grandis*, Hentschel, 1912, p. 337, pl. xviii, fig. 15.

OCCURRENCE.—Stn. XVII, 9th March, 1929 : $\frac{1}{2}$ mile N. of N. Direction Is., 19 fath., sand and thick *Halimeda*.

REMARKS.—The species is represented by two small massive specimens.

DISTRIBUTION.—Malay Area.

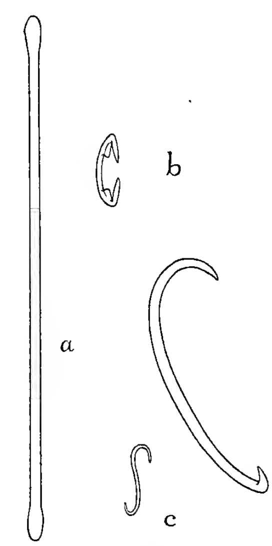
Mycale sulevoidea (Sollas).

Esperella sulevoidea, Sollas (Miss), 1902, p. 213, pl. xiv, figs. 8–9 ; pl. xv, fig. 10; *Mycale sulevoidea*, Hentschel, 1912, p. 335, pl. xii, fig. 6 ; pl. xviii, fig. 14.

OCCURRENCE.—Stn. XVII, 9th March, 1929 : $\frac{1}{2}$ mile N. of N. Direction Is., 19 fath., sand and thick *Halimeda*.

REMARKS.—There are three flagelliform sponges, of which the largest measures 35 cm. long and 1·5 cm. in diameter at the thickest point. The shape is unusual for the species, the only other specimens recorded being encrusting, but the spiculation leaves no doubt as to the identity of these specimens.

DISTRIBUTION.—Malay Area.



TEXT-FIG. 8.—*Histoderma calcifera*, sp. n. *a*, Tornote, × 190 ; *b*, chela, and *c*, sigmata, showing the range in size, × 500.

Section MYXILLEAE.

Genus *Histoderma*, Carter.

Histoderma calcifera, sp. n. (Text-fig. 8).

HOLOTYPE.—B.M. 30.8.13.228.

OCCURRENCE.—Stns. II and III, 24th November, 1928 : Linden Bank, 28 fath., shell sand.

DIAGNOSIS.—Body massive, entirely hidden by a covering of calcareous *débris*, with blind fistulae projecting upwards ; texture of body firm but compressible ; skeleton composed of amphitylota, tylostrongyla or strongyla, ·35 by ·007 mm., scattered without

order in inner tissues; microscleres chelae arcuatae, between ·02 and ·026 mm. chord and sigmata, varying from ·028 to ·07 mm. or more.

REMARKS.—The skeleton in this species contains nothing remarkable or characteristic, and differs from that of other species of *Histoderma* largely in the dimensions of the spicules. The external form, and particularly the coat of calcareous matter is, however, peculiar.

Genus *Hamigera*, Gray.

Hamigera strongylata, sp. n.

HOLOTYPE.—B.M. 30.8.13.79.

OCCURRENCE.—Stn. IX, 2nd February, 1929: Penguin Channel, 12–14 fath.; Stn. XII, 24th February, 1929: Penguin Channel, 10–15½ fath., rock and shell gravel.

DIAGNOSIS.—Sponge irregularly massive; surface uneven, glabrous; pore areas well-defined, numerous; oscules not apparent; colour, in spirit, yellowish grey; choanosome supported by an irregular reticulation of triangular, quadratic or polygonal mesh; dermis for most part aspiculous, except around pore-areas, where megascleres are radiately arranged; megascleres strongyla, with ends occasionally slightly swollen, ·28 by ·004 to ·008 mm.; microscleres isochelae of usual form ·03 mm.

REMARKS.—The species is unique in having only one form of megasclere. The chelae have almost the same form as those of *H. papillata*, Dendy and *H. dendyi*, Shaw, and it is possible that the present species may be a reduced form of one of these species or some allied species. Had it not been for the presence of characteristic pore-areas and chelae, which indicates the affinities to *Hamigera*, it would have been necessary to include this species among the reduced Myxilleae of uncertain affinity (see p. 554).

Genus *Plumocolumella*, Burton.

Plumocolumella anchorata (Carter).

*Axos** *anchorata*, Carter, 1881, p. 382, pl. xviii, fig. 3.

* *Axos*, Gray.

The genus *Axos*, established by Gray (1867, p. 545) for a spicule-drawing by Bowerbank (1862, p. 260, fig. 197), contains at present five species. In the British Museum collection there is a small portion of a sponge which may be accepted as the holotype of *A. cliftoni*, the genotype. This specimen is labelled, probably in Gray's handwriting, "*Axos cliftoni* Gray, West Australia, G. Clifton, Esq.," and its skeleton includes spicules of the form recorded by Bowerbank (*l. c.*, fig. 197). The complete spiculation consists of radial bundles of styli and an uninterrupted mass of asters filling both cortex and choanosome. The asters have six cylindrical rays, truncated and ornamented at the ends with four or more stout spines. Bowerbank's figure is badly drawn, and misleading, but it does illustrate the appearance of the spicule when seen from a certain angle. The typical appearance of the aster is, however, very like that of the micrasters of such species of *Tethya* as *T. robusta*, Bowerbank, and for this reason the genus *Axos* is here assigned to the family Tethyadae.

Of the remaining species *A. flabelliformis*, Carter (1879, p. 285, pl. xxvi, figs. 1–4), is congeneric with *A. cliftoni*, Gray; *A. spinipoculum* Carter (*l. c.*, p. 286, pl. xxv, figs. 1–9), belongs to the Acarneae; *A. fibulata*, Carter (1881, p. 383, pl. xviii, fig. 4), of which the holotype is lost, is probably identical with *Gelliodes fibulatus*, Ridley; and *A. anchorata*, Carter (*l. c.*, p. 382, pl. xviii, fig. 3), belongs to the Myxilleae and may be placed provisionally in the genus *Plumocolumella*, Burton (1929, p. 424). Further, *Axos spinipoculum*, Carter, must be assigned to a new genus for which the name *Diacarnus*, gen. n., is proposed, in recognition of its characteristic spicules, consisting of a straight shaft bearing a whorl of four recurved teeth just below the point at each end and two irregular whorls of spines near the centre. This spicule seems to be directly comparable with the cladotyla of *Acarnus*.

OCCURRENCE.—Stn. XXIII : Turtle Is., 8 fath., mud and shell.
DISTRIBUTION.—Bass Strait, Australia.

Genus *Strongylacidon*, Lendenfeld.

Strongylacidon inaequalis, Hentschel.

Batzella inaequalis, Hentschel, 1911, p. 325, fig. 20.

OCCURRENCE.—Stn. XIX : $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell, gravel and rich *Halimeda*.

REMARKS.—The first three specimens are in the form of extensive blue incrustations on a *Hircinia*. The fourth is small and massive, dark brown in colour, and consists of an irregular basal plate, from which spring small vertical lamellae, or digitate processes, with conulose surface. The fifth specimen, 9 cm. high, consists of a single lamella bearing lateral and terminal digitate processes. The surface is coarsely conulose and the colour, in spirit, dark brown. The skeleton in this specimen consists of a stout reticulation of horny fibres cored by irregularly plumose bundles of typical strongyla. In places the fibre disappears and the skeleton consists of feeble, plumose bundles of strongyla running towards the surface and ending there in feebly-marked surface brushes.

DISTRIBUTION.—S.W. Australia.

Strongylacidon intermedia, sp. n. (Text-fig. 9.)

HOLOTYPE.—B.M. 30.8.13.87.

OCCURRENCE.—Stn. XIX : $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell, gravel and rich *Halimeda*.

DIAGNOSIS.—Sponge massive, sub-clathrous, with short digitate processes given off at various points ; surface uneven, coarsely hispid, aculeate ; texture compressible ; oscules not seen ; colour, in spirit, pale greyish-brown ; skeleton composed of irregular fibres, branching and anastomosing, running generally towards the surface and cored by plumose bundles of slender strongyla, occasionally modified to styli, measuring ·14 by ·003 mm.

REMARKS.—The species differs from *S. inaequalis* (Hentschel), in that the spicules are collected into fibres and surrounded by spongin. On the other hand, it has considerable resemblance to *Echinochalina anomala*, Hallmann, and might almost be regarded as an *Echinochalina* which has lost its echinating styli.

Genus *Psammochela*, Dendy.

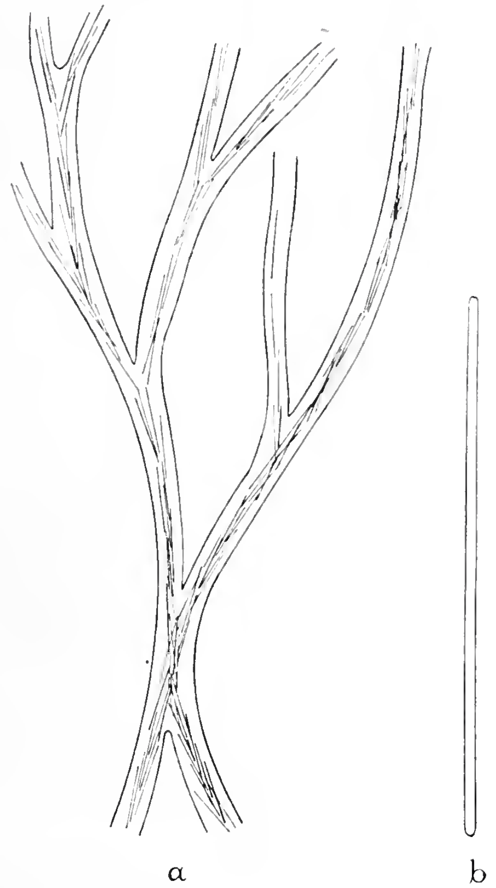
Psammochela fibrosa (Ridley).

Phoriospongia fibrosa, Ridley, 1884, p. 439, pl. xlii, fig. g ; *Psammochela elegans*, Dendy, 1916, p. 128, pl. i, fig. 6 ; pl. iii, fig. 22.

OCCURRENCE.—Stn. XXII, 11th March, 1929 : E. of Snake Reef, $13\frac{1}{2}$ fath., mud with foraminifera and shells, dredged.

REMARKS.—There can be little doubt that *Phoriospongia fibrosa*, Ridley, and *Psammochela elegans*, Dendy, represent a single species. The resemblance between them in external

form and in the types of spicules present is too great for it to be otherwise. Ridley (*loc. cit.*, p. 440) speaks of the megascleres as "acerates . . . with very slightly enlarged, subpyriform basal ends". In other words, the megascleres are "acuates" (= styli) not "acerates". The main difference between Dendy's and Ridley's specimens is in the composition of the skeleton fibres. Dendy describes them as "composed of sand-grains and megascleres in varying proportions with no visible spongin", but this description does not lay sufficient emphasis on the important details. In the majority of his specimens, for example, the fibres are filled almost entirely with styli, with little foreign



TEXT-FIG. 9.—*Strongylacidon intermedia*, sp. n. *a*, Portion of the skeleton showing the arrangement of the fibres, × 70; *b*, strongyle, × 500.

matter, but in R.N. IV.12, X and XXXIV.11, they are composed exclusively of sand and foraminiferal *débris*, with the styli sparingly associated. The condition found in these last three specimens is thus practically the same as that found in Ridley's sponges.

The present specimen is much macerated, and its identification is therefore doubtful. The external form is much the same as that of the irregularly massive forms described by Dendy, and the surface is irregularly conulose, but the dermal membrane which should span the intervals between the conuli is entirely absent. The skeleton is an irregular reticulation of horny fibres cored by bundles of slender styli, the styli measuring ·16 by ·001 to ·002 mm. Microscleres are entirely absent but in view of the macerated condition of the sponge this is not surprising. Assuming that this is truly a representative of *Psammochela fibrosa*, as seems probable, we have an interesting series of forms in which

the fibres of the skeleton show a wide range of variation. On the one hand, they may be composed of styli only, "with no visible spongin" (*fide* Dendy, *loc. cit.*, p. 126), or they may be composed entirely of sand-grains and calcareous *débris*, with only a small amount of spongin, or in extreme cases, foreign inclusions may be entirely absent and the skeleton consist of stout spongin fibres cored by proper megascleres. This is precisely the same as the sequence of variations found in *Spongelia fragilis* (see p. 583), and is comparable with the condition found in *Chondropsis chaliniformis* (see below). It is a striking illustration of the way in which the amount of spongin fluctuates in different individuals of a single species (*cf.* Burton, 1926).

DISTRIBUTION.—Indian Ocean; Northern Australia (Torres Straits).

Genus *Chondropsis*, Carter.

Chondropsis chaliniformis (Carter).

Dysidea chaliniformis, Carter, 1885, p. 217; *Phoriospongia chaliniformis*, Lendenfeld, 1889, p. 600, pl. xxxvii, fig. 8; pl. xl, figs. 1, 3; pl. xli, fig. 2; *Chondropsis chaliniformis*, Burton, 1929, p. 433.

OCCURRENCE.—Stns. II and III, 24th November, 1928: Linden Bank, 28 fath., shell and sand.

REMARKS.—The specimen consists of a mass of branches growing erect from a single stoloniform branch. The latter is angulate and irregular, but the erect branches are smooth and rounded, with a maximum diameter of 5 mm. In appearance the sponge approximates most nearly to the one recorded by me from the Antarctic, although differing in the composition of the skeleton. In the type the skeleton consists of stout fibres of spongin filled with large sand-grains. In the "Terra Nova" specimen, it is composed of foreign spicules exclusively, and in the present specimen of small sand-grains. The species shows, therefore, the same wide selection of extraneous matter for constructing a skeleton, as is seen in *Spongelia fragilis*.

There are also two small specimens of the dimensions and shape of those figured by Lendenfeld (*loc. cit.*, pl. xxxvii, fig. 8, and pl. xl, fig. 3). The fibres of the skeleton are filled with sand-grains of the same size as those found in the type of the species, but there are, in addition, so many foreign spicules present that it is practically impossible to determine whether proper megascleres are present or not.

The embryo of this species has been figured by Lendenfeld and it is noteworthy that an incipient tangential dermal skeleton is present (*cf.* Burton, 1931, p. 523).

DISTRIBUTION.—Australia (north, east and south coasts) (*fide* Lendenfeld, *loc. cit.*); McMurdo Sound, Antarctic.

Chondropsis carcinophila, Lendenfeld.

Sigmatella carcinophila, Lendenfeld, 1889, p. 615, pl. xli, fig. 8.

OCCURRENCE.—Stn. XIX, 10th March, 1929: about ½ mile N. of Eagle Is., 10 fath.

REMARKS.—The specimen has been dissected for the removal of a number of parasitic (?) Amphipoda, but appears to have been massive and low-growing. Its dimensions were approximately 2½ by 2 cm. across by ·5 cm. high. The surface is tolerably smooth, but

thrown into a number of low tubercles or rounded ridges. The choanosome is densely crowded with foreign matter, chiefly sand, arranged as in *Sigmatella australis*, var. *tubaria*, Lendenfeld (*loc. cit.*, pl. xlii, fig. 5), but more abundantly present. Associated with this sandy skeleton are a number of slender spicules, probably strongyla, so much mixed up with sand-grains that it is not possible to be quite certain of the shape of their ends. They measure ·2 by ·001 mm., and are usually flexuous.

This specimen seems to agree with *S. carcinophila*, Lendenfeld, in all essential features except that the surface is not conulose but tuberculate or ridged.

Distribution.—Australia (east coast).

Genus *Iotrochota*, Ridley.

Iotrochota purpurea (Bowerbank).

Halichondra purpurea, Bowerbank, 1875, p. 293; *Iotrochota purpurea*, Ridley, 1884, p. 434, pl. xxxix, fig. L; pl. xlii, fig. e; Topsent, 1897, p. 455; Dendy, 1905, p. 164; Hentschel, 1912, p. 348; Dendy, 1921, p. 97.

Occurrence.—Low Isles, the Thalamita Flat.

Remarks.—The first three specimens are thinly encrusting, with here and there an incipient branch growing upwards. A fourth specimen is branched and closely resembles that figured by Ridley (*loc. cit.*, pl. xxxix, fig. L).

The colour in life has been variously recorded as velvet-black and indigo.

Distribution.—Malay Area; Indian Ocean.

Iotrochota coccinea (Carter).

Halichondria birotula, Carter, 1886, p. 52 (*nec Halichondria birotula*, Higgin); *Axinella coccinea*, Carter, 1886, p. 378; *Iotrochota coccinea*, Dendy, 1896, p. 23.

Occurrence.—Stn. X, 22nd February, 1929: Satellite Reef, 14–17 fath., coral, shell, gravel and mud.

Remarks.—The specimen agrees closely with the type in general features, but differs in the megascleres, which though of typical dimensions are exclusively strongylote.

Distribution.—Australia (south coast).

Genus *Crella*, Gray.

Crella spinulata (Hentschel).

Grayella spinulata, Hentschel, 1911, p. 340, fig. 29.

Occurrence.—Stn. IX, 22nd February, 1929: Penguin Channel, 12–14 fath., mud. Stn. XII, 24th February, 1929: Penguin Channel, 10–15½ fath., rock and shell gravel, mud on edges of pit. Stn. XXII, 11th March, 1929: E. of Snake Reef, 13½ fath., mud with foraminifera and shells.

Remarks.—The sponge is branching, with branches cylindrical and 3–5 mm. in diameter, and agrees with the holotype in external features. The spicules have the same form and dimensions as those of the holotype, but differ slightly in arrangement. The

dermal skeleton is typical, but the main skeleton consists of a regular reticulation of triangular mesh, formed by the acanthoxea with occasional bundles of tornota running towards the surface.

Distribution.—S.W. Australia.

Appendix to the Myxilleae.

There are many species of doubtful affinity in which the spiculation consists of smooth monactinal or diactinal megascleres, with some form of chela for microscleres, and the practice has been hitherto to refer these to either the genus *Batzella*, or the genus *Desmacidon*, in the sub-family Isodictyeae, so that these two genera have tended, in practice, to serve for the reception of all Desmacidonidae of doubtful affinity. The Isodictyeae was intended to include, in the first place, the genus *Isodictya*, with genotype *I. palmata*, Johnston, which has oxeote megascleres and chelae and sigmata for microscleres, and differs from the genus *Chalina* almost entirely in the possession of microscleres. In the genus *Batzella* and such species as *Desmacidon plicatum*, Hentschel, *D. psammodes*, Hentschel, *D. arenosa*, Whitelegge, *D. chaliniformis* (Carter), Dendy, *D. stelliderma* (Carter) Dendy, and *D. dendyi*, Whitelegge, the megascleres, where present, are tornota and this alone justifies their removal from the Isodictyeae to the Myxilleae, the characteristic feature of which is the possession of tornota of various forms as auxiliary spicules, either forming a dermal skeleton exclusively, or, as in *Anchinoë*, entering also into the main skeleton.

The type of the genus *Batzella*, *B. inops*, Topsent, has, according to the original description, strongyla (? tornota) scattered loosely in the tissues, but the description of the skeleton is not sufficient to settle beyond doubt the affinities of the species. *Desmacidon columella*, Bowerbank, also referred to *Batzella*, has unequally ended strongyla and styli for megascleres, but no microscleres, and is evidently a reduced *Mycale*. A new genus must, therefore, be made for its reception, and for this I propose the name, *Hemimycale*, gen. n. *Batzella corticata*, Thiele, is closely related to *Rhaphoxya*, Hallmann, but differs in having a tangential dermal layer of short strongyla, not recorded by Thiele, about half the length of the principal megascleres. For this species I propose the name *Rhaphoxiella*, gen. n. *Batzella mollis*, on the other hand, belongs to *Rhaphoxya*, while *Batzella inaequalis*, Hentschel (1911), although without microscleres, may justly be referred to *Strongylacidon*, for although the megascleres tend to be anisostrongylote, their arrangement in the skeleton is much the same as in *S. sansibarensis*, Lendenfeld, the genotype.

Desmacidon plicatum, Hentschel, is identical with *Halichondria stelliderma*, Carter (= *Desmacidon stelliderma* (Carter)), a species which rightly belongs to *Strongylacidon*, but *Desmacidon psammodes*, Hentschel, represents one new genus, and *Homœodictya dendyi*, Hentschel, represents a second, for which the names *Anomomyxilla*, gen. n., and *Anomodoryx*, gen. n., are here proposed. *Desmacidon arenosa*, Whitelegge, and *D. chaliniformis* (Carter), Dendy, are species of very doubtful affinity in which the skeleton, except for the microscleres, which resemble those of the Myxilleae, is replaced by sand and other foreign inclusions. For these, too, a new genus is necessary, and the name *Psammodoryx*, gen. n., is proposed.

All these forms are of doubtful affinity but, with the exception of *Hemimycale* and *Rhaphoxiella*, show some relationship to the Myxilleae and, pending further information,

should be included in an appendix to that sub-family. *Plumocolumella*, Burton, must likewise be included in such an appendix.

The following is a summary of the genera discussed above :

Genus *Batzella*, Topsent.

GENOTYPE.—*Halichondria inops*, Topsent, 1891, p. 533, pl. xxii, fig. 1.

DIAGNOSIS.—Reduced Myxilleae with skeleton composed of slender strongyla scattered sparsely throughout choanosome ; no special dermal skeleton ; no microscleres.

Genus monotypic.

Genus *Strongylacidon*, Lendenfeld.

GENOTYPE.—*Strongylacidon sansibarensis*, Lendenfeld, 1897, p. 110, pl. x, figs. 106–116.

DIAGNOSIS.—Reduced Myxilleae with skeleton of slender strongyla, often slightly tylote at one or both ends, arranged in loose fibres running vertically to surface ; fibres tending to branch and anastomose in places, giving rise to an irregular network ; distal end of fibres projecting slightly at surfaces ; no special dermal skeleton ; microscleres chelae unguiferae.

The above diagnosis is based on examination of a preparation from the holotype in the British Museum collection.

Genus includes : *S. sansibarensis*, Lendenfeld, *Halichondria stelliderma*, Carter (with its synonym *Desmacidon plicatum*, Hentschel).

Genus *Plumocolumella*, Burton.

GENOTYPE.—*Fibulia carnosa*, Carter, 1886, p. 51.

DIAGNOSIS.—Reduced Myxilleae with skeleton of bundles of oxeote tornota running vertically to surface and ending in dermal brushes ; fibres usually curved or sinuous, often branching and anastomosing to form an irregular network ; microscleres isochelae unguiferae.

For list of species, see Burton, *loc. cit.*, p. 425.

Genus *Anomomyxilla*, gen. n.

GENOTYPE.—*Desmacidon psammodes*, Hentschel, 1911, p. 322, fig. 19.

DIAGNOSIS.—Reduced Myxilleae with skeleton of slender strongylote tornota, sometimes modified to irregular styli, arranged in loose fibres running vertically to surface and ending in loose dermal brushes ; fibres tending to branch and anastomose giving rise, in places, to an irregular network ; main skeleton containing much sand and foreign spicules ; dermis supported by a close-meshed network of fibre filled with sand and foreign spicules ; microscleres isochelae unguiferae and sigmata.

Genus monotypic.

Genus *Anomodoryx*, gen. n.

GENOTYPE.—*Desmacidon dendyi*, Whitelegge, 1902, p. 79, pl. x, fig. 9.

DIAGNOSIS.—Reduced Myxilleae with skeleton of amphitylote tornota arranged in slender fibres which branch and anastomose to form radial fibre systems running vertically to surface ; no special dermal skeleton ; microscleres chelae arcuatae and sigmata.

Genus monotypic.

Genus *Psammodoryx*, gen. n.

Genotype.—*Dysidea chaliniformis*, Carter, 1885, p. 217.

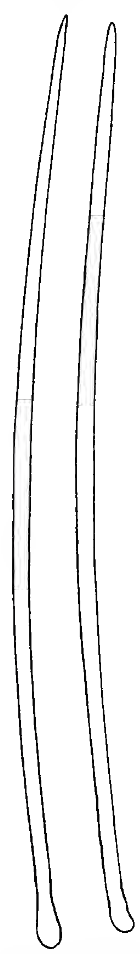
Diagnosis.—Reduced Myxilleae (?) with skeleton composed of a reticulation of horny fibres filled with sand and foreign spicules ; microscleres isochelae unguiferae.

The genus includes, besides the genotype, *Desmacidon arenosa*, Whitelegge.

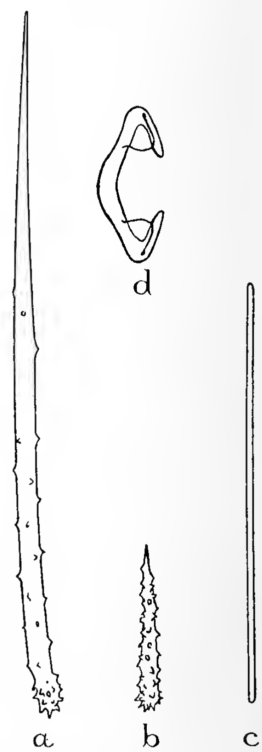
Hemimycale, gen. n. (Text-fig. 10.)

Genotype.—*Desmacidon columella*, Bowerbank, 1874, p. 243, pl. lxxviii, figs. 6–8.

Diagnosis.—Reduced Mycaleae with skeleton of loose fibres of styli, sometimes modified to anisostrongyla, running vertically to surface ; fibres tending to branch and anastomose ; no special dermal skeleton ; no microscleres.



Text-fig. 10.—Spicules of *Hemimycale*, gen. n., *columella* (Bowerbank), × 300.



Text-fig. 11.—*Hymedesmia*, cf. *tenuissima* (Dendy). *a*, Large acanthostyle ; *b*, small acanthostyle ; and *c*, tornote, × 300 ; *d*, chela, × 360.

Hemimycale columella (Bowerbank) is a species of uncertain affinity and has, as a result, been placed in several different genera at different times. The original figure of its spicules is erroneous and has led to much misconception. Instead of anisostrongyla, such as figured by Bowerbank, its skeleton is composed of styli (Text-fig. 10), with occasional strongyla as a modification of these. There is good reason, therefore, for placing the species among the Mycaleae.

Genus *Rhaphoxiella*, gen. n.

GENOTYPE.—*Batzella corticata*, Thiele, 1905, p. 438, fig. 58.

DIAGNOSIS.—Axinellidae with skeleton of loose, irregular fibres, formed of curved styli, oxea or strongyla, running vertically to surface; numerous spicules, including also short oxea and strongyla, scattered between fibres; dermal skeleton a tangential reticulation of short strongyla; no microscleres.

Genus monotypic.

Section CLATHRIEAE.

Genus *Hymedesmia*, Bowerbank.

Hymedesmia mertoni, Hentschel.

H. mertoni, Hentschel, 1912, p. 376, pl. xx, fig. 34.

OCCURRENCE.—Stn. XXV, 17th March, 1929: in Papuan Pass, 20–25 fath., foraminifera and coral fragments.

REMARKS.—A thin incrustation on *Hyatella sinuosa* has a similar spiculation to that described by Hentschel for *Hymedesmia mertoni*. It differs in the absence of the larger sigmata, and of the smaller chelae, and in having longer tornota, measuring up to ·16 mm. long. The larger acanthostyli, too, measure no more than ·14 mm. These differences are, however, of doubtful importance.

H. mertoni is evidently the post-larval form of a species of Myxilleae, and the spicular characters at such a stage are probably subject to a greater variation than at any other stage in the life-history. This I hope to demonstrate shortly in dealing with the post-larval stages of species of sponges from the British Isles. Meanwhile, I propose to regard the present specimen, despite its differences, as a representative of this species.

DISTRIBUTION.—Malay Area.

Hymedesmia cf. *tenuissima* (Dendy). (Text-fig. 11.)

Myxilla tenuissima, Dendy, 1905, p. 169, pl. xi, fig. 5.

OCCURRENCE.—Stn. XXV, 17th March, 1929: In Papuan Pass, 20–25 fath., foraminifera and coral fragments.

REMARKS.—The specimen forms a thin incrustation on *Thorectopsamma irregularis*, sp. n. The skeleton consists of acanthostyli of two sizes, measuring ·315 and ·07 mm. long respectively, the longer basally-spined, and the shorter entirely-spined, which echinate the surface of the *Thorectopsamma*. Strongylote tornota, measuring ·18 by ·002 mm., are associated with the acanthostyli and disposed usually at right angles to them. The microscleres are chelae arcuatae measuring ·028 mm. chord.

The specimen agrees with *Hymedesmia tenuissima* (Dendy) in general appearance only, but the latter has no long acanthostyli, and its chelae are more robust. Both are probably young forms of a single species in which case the differences between them are unimportant.

DISTRIBUTION.—Ceylon.

Genus *Paracornulum*, Hallmann.

Paracornulum dubium (Hentschel).

Cornulum dubium, Hentschel, 1912, p. 346, pl. xix, fig. 19 ; *Paracornulum dubium*, Hallmann, 1920, p. 772.

Occurrence.—Stn. XVIII, 9th March, 1929 : $\frac{1}{4}$ mile N. of N. Direction Is., 20 fath., sand and thick *Halimeda*.

Distribution.—Aru Island.

Genus *Clathria*, Schmidt.

Clathria, Schmidt, 1862, p. 57 ; *Echinoclathria*, Carter, 1884, p. 204 ; *Antherochalina*, Lendenfeld, 1887, p. 786.

Remarks.—Reasons are given under *Echinochalina* (see p. 562) for regarding *Echinoclathria*, Carter, as a synonym of *Clathria*.

The genus *Antherochalina*, Lendenfeld, was founded for the reception of *Veluspa polymorpha*, var. *infundibuliformis*, Maclay, and for 8 new species in addition. In the ordinary course of events the first-named species would be taken as lectotype, but since in this case it is imperfectly known, the first of the new species, *Antherochalina crassa*, is chosen. This species belongs to the genus *Clathria* and *Antherochalina* must accordingly be regarded as a synonym thereof. The remaining species of *Antherochalina* may be identified as follows :

A. elegans	=	*Syringella elegans* (Lendenfeld).
A. frondosa	=	*Clathria frondosa* (Lendenfeld).
A. renieroides	=	*Phakellia flabellata* (Carter).
A. dura	=	*Phakellia flabellata* (Carter).
A. concentrica	=	*Phakellia flabellata* (Carter).
A. perforata	=	*Ophlitaspongia* (*Echinoclathria*) *tenuis* (Carter).
A. tenuispina	=	*Ophlitaspongia* (*Echinoclathria*) *tenuis* (Carter).

Clathria aculeata, Ridley.

C. aculeata, Ridley, 1884, p. 443, pl. xl, fig. I ; pl. xlii, fig. K ; Ridley and Dendy, 1887, p. 147.

Occurrence.—Low Isles, the Thalamita Flat, between Porites Pond and North-east Moat, and south of Tripneustes Spit.

Distribution.—Torres Strait.

Clathria rubens (Lendenfeld).

(For synonymy and description see Hallmann, 1912, p. 218.)

Occurrence.—Stns. II and III, 24th November, 1929: Linden Bank, 28 fath., shell and sand. Stn. XVI : $\frac{1}{2}$ mile W. of N. Direction Is., 20 fath., stony. Stn. XVII, 9th March, 1929 : $\frac{1}{4}$ mile W. of N. Direction Is., 19 fath., sand, thick *Halimeda*. Stn. XIX, 10th March, 1929 : $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*.

Remarks.—The first specimen is practically identical with that figured by Hallmann

(*loc. cit.*. pl. xxxii, fig. 1), but differs in having toxa which rarely, if ever, exceed ·06 mm. in length. The other three have an external form very like that of *Ophlitaspongia subhispida* (Carter) as figured by Hallmann (1912, pl. xxxvi, fig. 1), and a spiculation which may be regarded as intermediate between that of *O. subhispida* and *Clathria rubens*. In order that the spiculation of the first of these species should be derived from the second, all that is necessary is a shortening of the toxa, the loss of the already rare chelae, and the complete suppression of the already rare spines on the accessory styli. These changes are partially realized in the specimens here assigned to *C. rubens*.

From Hallmann's (*loc. cit.*, p. 226) description of *C. transiens*, this species seems to be exactly intermediate between *C. rubens* and *Ophlitaspongia subhispida* in spiculation, while its external form approaches that of the present specimens of *C. rubens*.

In a revision of the species of Clathrieae, it would be necessary, therefore, to consider the possibility that these three species may be synonymous.

Distribution.—Australia (east coast).

Genus *Tenacia*, Schmidt.

Tenacia frondifera (Bowerbank).

Halichondria frondifera, Bowerbank, 1875, p. 288; *Amphilectus frondifer*, Vosmaer, 1880, p. 115; *Clathria frondifera*, Ridley, 1884, p. 448, pl. xlii, fig. i; pl. liii, fig. j; Ridley and Dendy, 1887, p. 149; Topsent, 1892, p. 23; Lindgren, 1897, p. 480; *idem*, 1898, p. 27; Dendy, 1905, p. 170; Hentschel, 1912, p. 360.

Occurrence.—Stn. IX, 22nd February, 1929: Penguin Channel, 12–14 fath., sand and thick *Halimeda*.

Remarks.—Although this species has been referred persistently to *Clathria*, it really belongs to *Tenacia*.

Distribution.—Red Sea; Indian Ocean; Malay Area; Australia (north coast).

Tenacia procera (Ridley).

(For synonymy see Dendy, 1921, p. 64, under *Clathria procera*.)

Occurrence.—Stn. XII, 24th February, 1929: Penguin Channel, 10–15½ fath., rock and shell gravel, mud on edges of pit. Stn. XVII, 9th March, 1929: ¼ mile N. of N. Direction Is., 19 fath., sand and thick *Halimeda*.

Distribution.—Indian Ocean; Australia (north coast).

Tenacia paucispina (Lendenfeld).

(For synonymy and description see Hallmann, 1912, p. 178, under *Rhaphidophlus paucispinus*.)

Occurrence.—Stn. XII, 24th February, 1929: Penguin Channel, 10–15½ fath., rock and shell gravel.

Remarks.—The present specimen consists of a tangled, anastomosing mass of angular and somewhat nodose branches, each 3–5 mm. in diameter. It corresponds more closely in form with the var. *multiporous*, Whitelegge, than with the typical form, but the spicules are quite typical, except that the toxa may occasionally reach a length of ·16 mm.

Distribution.—Australia (east coast).

Tenacia coralliophila (Thiele).

Rhaphidophlus coralliophilus, Thiele, 1903, p. 959, fig. 25.

Occurrence.—Low Isles, the Thalamita Flat.

Remarks.—The single specimen forms a low, irregularly-massive incrustation, and was named by its collectors the "red, conical sponge". The dimensions of the spicules are: Stout styli, ·36 by ·012 mm.; large subtylostyli, ·56 by ·012 mm.; small subtylostyli, ·26 by ·007 mm.; acanthostyli, ·14 mm. long; chelae ·016 mm. and toxa ·06–·2 mm. The size of the various categories of spicules varies a good deal, and intermediate forms between the styli and the two kinds of subtylostyli appear to be common.

Distribution.—Ternate.

Genus *Ophlitaspongia*, Bowerbank.

Ophlitaspongia rimosa (Ridley).

Desmacidon rimosa, Ridley, 1884, p. 609, pl. liii, fig. F; pl. liv, fig. m.

Occurrence.—Low Isles, Inner Ramparts and the Thalamita Flat.

Remarks.—The several specimens are all in the form of low, rounded cushions, with furrowed surfaces, resembling extremely closely the holotype. The colour, in spirit, varies from a pale flesh tint to drab, but in life it was green, brown and scarlet lake.

The occurrence of this species on the Great Barrier Reef is of unusual interest, since this is only the second record of it, the first being from East Africa.

Distribution.—Mozambique, Portuguese East Africa.

Ophlitaspongia eccentrica, sp. n. (Plate I, figs. 8, 9; Text-fig. 12A.)

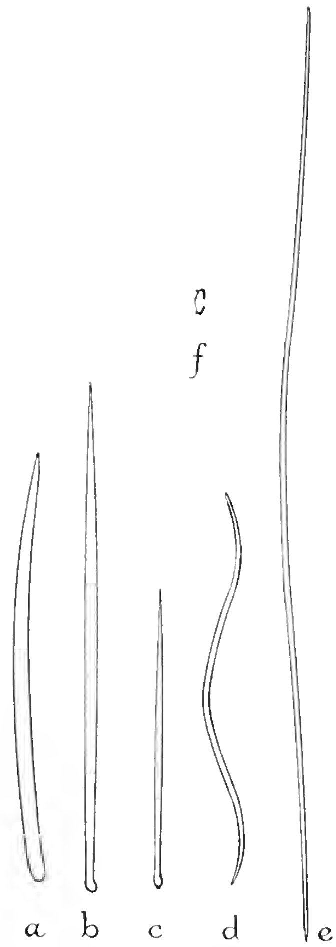
Holotype.—B.M. 30.8.13.109.

Occurrence.—Low Isles, Crab Spit.

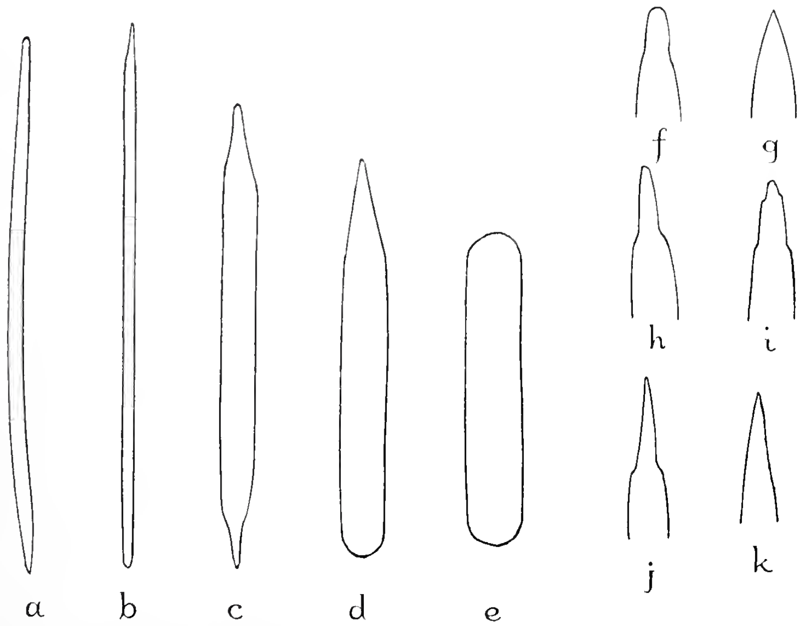
Diagnosis.—Sponge encrusting, massive or irregularly lamellate; skeleton composed of an irregular network of fibres cored by smooth styli, with smooth slender styli of two sizes occurring interstitially; microscleres palmate isochelae and toxa (merging into toxiform oxea ?).

Remarks.—The specimens upon which the diagnosis of this species is based are in a poor state of preservation. Nothing but the skeleton is left, so that it is impossible to describe the external characters apart from the shape. The coring spicules measure ·36 by ·017 mm., the interstitial styli, of two sizes, ·44 by ·008 mm., and ·24 by ·005 mm. Oxea (modified toxa ?) of various sizes, up to ·8 by ·007 mm., occur scattered sparsely in the meshes of the main skeleton, and toxa, up to ·32 by ·004 mm., and chelae, from ·014 to ·018 mm. long, are also present.

The species is peculiar in the presence of oxea, presumably derived by modification from the toxa, and in the differentiation of the auxiliary styli into two distinct sizes.



Text-fig. 12a.—*Ophlitaspongia eccentrica*, sp. n. *a*, Style of main fibres; *b* and *c*, interstitial styli or subtylostyli; *d*, toxote; *e*, toxiform oxeote; and *f*, chela; all × 150.



Text-fig. 12b.—*Protophlitaspongia oxeata*, sp. n. *a*, *b*, oxea; *c–e*, abnormal forms of megascleres; *f–k*, ends of oxea enlarged. *a–e*, × 500; *f–k*, × 1,500.

Protophlitaspongia, gen. n.

Genotype.—*Siphonochalina bispiculata*, Dendy.

Diagnosis.—Clathrieae with skeleton composed of an irregular reticulation of spongin fibres cored by hastately-pointed oxea, with numerous similar spicules scattered in its meshes ; without special dermal skeleton or microscleres.

Remarks.—The affinities of this genus are obscure, and the supposed relationships to the other Clathrieae rest rather on suggested resemblances of the spicules to similar spicules in *Ophlitaspongia* than on any obvious feature. Dendy's (1895, p. 246) description of the skeleton of *Siphonochalina bispiculata* is quite clear and accurate except that there is no dermal skeleton and the spicules scattered in the soft tissues are numerous. His suggestion that "there is a well-developed dermal skeleton composed of radiating tufts of long slender oxea" is incorrect ; these tufts being merely the projecting ends of the spicules coring the main fibres, and not in any sense constituting a special dermal skeleton. The short oxea I do not regard as microscleres since they are connected to the larger spicules by intermediates and resemble them in all respects but size.

Protophlitaspongia oxeata, sp. n. (Text-fig. 12B.)

Holotype.—B.M. 30.8.13.45.

Occurrence.—Stn. XXV, 17th March, 1929 : In Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Diagnosis.—Sponge ramose, branches cylindrical, 3–5 mm. diameter ; surface smooth, even, porose ; texture tough, elastic ; colour, in spirit, light brown ; oscules few, conspicuous, 1–2 mm. diameter, arranged in linear series ; skeleton an irregular reticulation of fibres, in which primary fibres usually contain multiserially-arranged spicules and secondaries are aspiculous or contain a single row of spicules ; numerous spicules scattered between meshes of main skeleton ; spicules hastately-pointed oxea, ·16 by ·004 mm., occasionally modified to styli.

Remarks.—The species differs from the genotype mainly in the external form and in the absence of the small oxea.

Genus *Echinochalina*, Thiele.

Genotype.—*Ophlitaspongia australiensis*, Ridley.

Remarks.—There is a good deal of confusion concerning the genera *Echinochalina*, Thiele, and *Echinoclathria*, Carter, resulting mainly from the errors of Ridley and Dendy, and Hallmann. *Echinoclathria* was proposed by Carter (1884, p. 204), without diagnosis or genotype, but with recognizable descriptions of some unnamed species. The identity of these species is doubtful, but the meagre descriptions of them suggest that the genus *Clathria* would have been more appropriate for their reception. The following year, Carter (1885, pp. 355–7) added four new species to the genus. The first of these, *Echinoclathria tenuis*, here chosen as genolectotype, is a *Clathria*, and, of the remainder, *Echinoclathria nodosa* and *E. subhispida* belong to *Ophlitaspongia*. The fourth, *Echinoclathria*

gracilis. is congeneric with *Ophlitaspongia australiensis*, Ridley, the genotype of *Echinochalina*, Thiele (1903, p. 961). *Echinoclathria* is therefore a synonym of *Clathria*, but Ridley and Dendy referred to it a number of species rightly belonging to *Echinochalina*. To make matters worse, Hallmann (1912, p. 288) accepted Thiele's genus *Echinochalina*, but amended the diagnosis so as to exclude the genotype. Actually, such action was not only incorrect but quite unnecessary, for *Echinochalina*, in the sense in which Thiele intended it, may be used to include not only the genotype but also those species which Hallmann wished to put in it.

Echinochalina intermedia (Whitelegge).

(For possible synonymy see Dendy, 1921, p. 71, under *Echinoclathria intermedia*.)

Occurrence.—Stn. XVI, 9th March, 1929 : ½ mile W. of N. Direction Is., 20 fath., stony.

Remarks.—The specimen, though of larger size, agrees almost exactly with that described by Dendy (*loc. cit.*). Whether these two are conspecific with the holotype and other specimens recorded from Australia, is, however, a matter of doubt.

Distribution.—Indian Ocean ; Australia (east coast).

Echinochalina anomala, Hallmann. (Plate I, fig. 13.)

Echinochalina anomala, Hallmann, 1912, p. 292, fig. 68.

Occurrence.—Stn. XIX, 10th March, 1929 : ½ mile N. of Eagle Is., 10 fath., shell gravel and rich *Halimeda*.

Remarks.—As the external form of the species has never been illustrated, and is in fact known only from imperfect material, a photograph of the present specimen is given.

Distribution.—Australia (east coast).

Coelocarteria, gen. n.

Genotype.—*Phloeodictyon singaporense*, Carter.

Diagnosis.—Clathrieae with skeleton composed of long oxea, often modified to strongyla, and short strongyla, with minute palmate isochelae for microscleres.

Coelocarteria singaporense (Carter).

Phloeodictyon singaporense, Carter, 1883, p. 326, pl. xiii, fig. 17 ; *Rhizochalina singaporensis*, var., Ridley, 1884, p. 421, pl. xli, fig. s ; *R. singaporensis*, Ridley and Dendy, 1887, p. 34 ; Lindgren, 1897, p. 481 ; *idem*, 1898, p. 297, pl. xix, fig. 11 ; *Histoderma singaporense*, Thiele, 1903, p. 955.

Occurrence.—Stn. XVII, 9th March, 1929 : ¼ mile N. of N. Direction Is., 19 fath., sand and thick *Halimeda* ; Stn. XVIII, 9th March, 1929 : ½ mile S.E. of Lizard Is., 20 fath., shell, gravel and rich *Halimeda*.

Distribution.—Malay Area.

Family Axinellidae.

Genus *Trachyopsis*, Dendy.

Trachyopsis halichondrioides, Dendy.

T. halichondrioides, Dendy, 1905, p. 147, pl. x, fig. 10; Burton, 1926, p. 75, figs. 6–7.

Occurrence.—Stn. XXIV, 13th March, 1929: $\frac{3}{4}$ mile N.E. Pasco Reef, $16\frac{1}{2}$ fath., hard and shell bottom.

Distribution.—Indian Ocean.

Trachyopsis aplysinoides (Dendy).

Halichondria aplysinoides, Dendy, 1921, p. 39, pl. iii, figs. 3–5; pl. xii, fig. 9; *Trachyopsis aplysinoides*, Burton, 1926, p. 78.

Occurrence.—Stn. X, 22nd February, 1929: Satellite Reef, 14–17 fath., coral, shell, gravel and mud.

Distribution.—Indian Ocean.

Genus *Leucophloeus*, Carter.

Leucophloeus fenestratus, Ridley.

L. fenestratus, Ridley, 1884, p. 464, pl. xii, fig. s; *Hymeniacidon fenestratus*, Lindgren, 1897, p. 483; *idem*, 1898, p. 312, p. 124; *nec Leucophloeus fenestratus*, Dendy, 1921.

Occurrence.—Low Isles, Mangrove Park.

Distribution.—Malay Area: Australia.

Genus *Ciocalypta*, Bowerbank.

Ciocalypta penicillus (Bowerbank).

(For synonymy see Topsent, 1921, p. 687.)

Occurrence.—Stn. XVI, 9th March, 1929: $\frac{1}{2}$ mile W. of N. Direction Is., 20 fath., stony.

Distribution.—Eastern Atlantic from N. Europe to S. Africa; Indian Ocean; Malay Area; Australia (all coasts).

Genus *Collocalypta*, Dendy.

Collocalypta mertoni (Hentschel).

Ciocalypta mertoni, Hentschel, 1912, p. 424, pl. xiv, fig. 4; pl. xxi, fig. 59.

Occurrence.—Stn. XXIII, 12th March, 1929: Turtle Is., 8 fath., mud and shell.

Distribution.—Aru Is.

Genus *Acanthella*, Schmidt.

Acanthella cavernosa, Dendy.

A. stipitata, Carter, var. Ridley and Dendy, 1887, p. 178 ; *A. cavernosa*, Dendy, 1921, p. 120, pl. vii, fig. 7 ; pl. xvii, fig. 3.

Occurrence.—Off North Anchorage. 17th October, 1928, 9 fath. Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., mud and rock. Stn. XXV, 17th March, 1929 : In Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Remarks.—The three specimens vary slightly in shape but agree closely in spiculation. One of them is almost identical externally with the holotype of *A. cavernosa*, while the other two resemble *A. vulgata*, Thiele, from Japan. The spiculation in each case is approximately the same as that of *A. cavernosa*.

Since Ridley and Dendy believed their specimen to be very like the type of *A. stipitata*, Carter, a word of explanation is necessary here regarding our knowledge of that species. According to the original description the spiculation of *A. stipitata* consists of styli only, and the species is therefore not a true *Acanthella*. In any case, however, it is so inadequately described as to be practically unrecognizable. *A. stipitata*, Carter, recorded by Dendy (1897, p. 237), is a *Rhaphoxya* and identical with *R.* (*Acanthella*) *cactiformis* (Carter).

Distribution.—Australia (north coast) ; Indian Ocean.

Genus *Pararhaphoxya*, gen. n.

Genotype.—*P. tenuiramosa*, sp. n.

Diagnosis.—Axinellidae with axial skeleton of flexuous strongyla and curved oxea and styli ; with an extra-axial skeleton of oxea ; spicules slender and irregularly ended.

Remarks.—The genus combines some characters of both the genera *Phakellia* and *Rhaphoxya*. The skeleton arrangement is the same as in *Phakellia*, and the flexuous strongyla typical of it are present, but the oxea and styli have the same slender character and the same peculiar ends as those of *Rhaphoxya*.

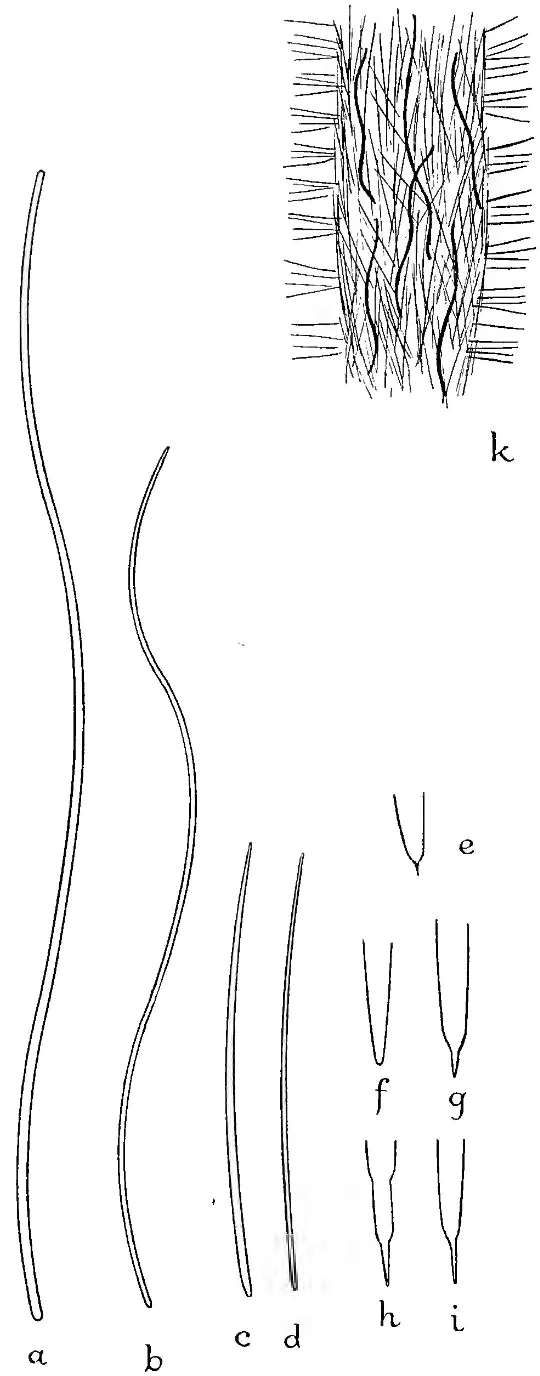
Pararhaphoxya tenuiramosa, sp. n. (Text-fig. 13.)

Holotype.—B.M. 30.8.13.145.

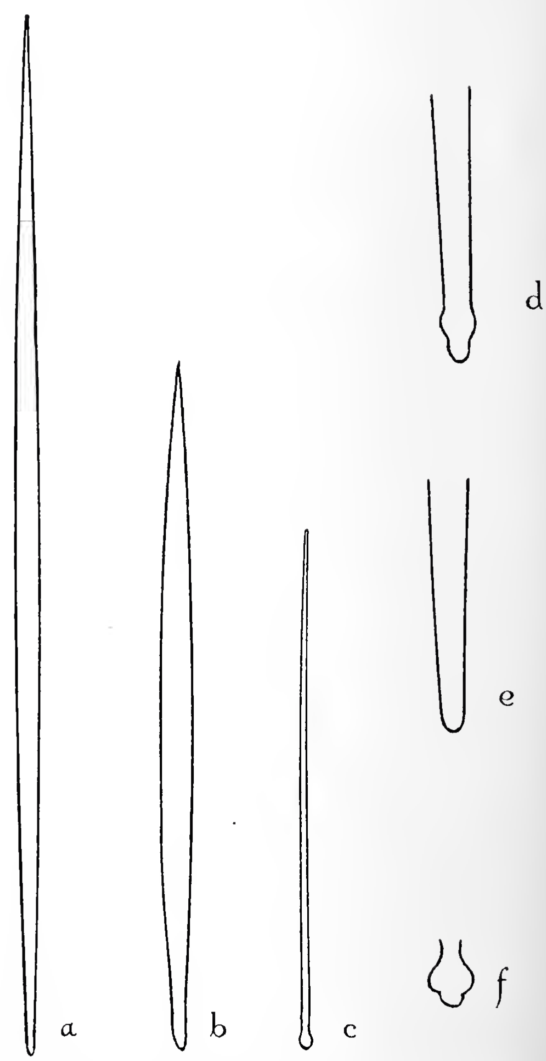
Occurrence.—Stn. XVI, 9th March, 1929 : ½ mile W. of N. Direction Is., 20 fath., stony.

Diagnosis.—Sponge stipitate, dichotomously branched ; branches slender, maximum diameter 3 mm. ; surface hispid ; colour, in spirit, greyish-white ; oscules small, inconspicuous, distributed over sides of branches ; skeleton composed of an axial core of flexuous strongyla, curved oxea and styli arranged longitudinally, and an extra-axial, radially-arranged skeleton of curved oxea ; strongyla varying in length and diameter, up to 1·5 mm. long and ·004–·014 mm. in diameter, and oxea and styli up to ·6 by ·006 mm.

Remarks.—The holotype consists of a short stem bearing very slender, regularly dichotomosing branches, rising to a height of 20 cm.



TEXT-FIG. 13.—*Pararaphoxya tenuiramosa*, sp. n. *a*, Flexuous strongyle; *b*, flexuous oxeote; *c* and *d*, styli, × 100; *e–i*, ends of oxea enlarged; *k*, longitudinal section through a branch to show disposition of skeleton, semi-diagrammatic.



TEXT-FIG. 14.—Spicules of *Polymastia megasclera*, sp. n. *a*, Subtylostyle of radial bundles; *b*, subtylostyle of cortical palisade, and *c*, tylostyle of sub-cortical tangential layer, all × 100; *d* and *e*, variations found in the bases of *a* and *b*; *f*, enlarged view of base of *c*.

Family Suberitidae.

Genus *Pseudosuberites*, Topsent.

Pseudosuberites andrewsi, Kirkpatrick.

P. andrewsi, Kirkpatrick, 1900, p. 135, pl. xii, fig. 2; pl. xiii, fig. 7.

Occurrence.—Low Isles, the Thalamita Flat.
Distribution.—Xmas Is.

Genus *Laxosuberites*, Topsent.

Laxosuberites proteus, Hentschel.

L. proteus, Hentschel, 1909, p. 389, pl. xxii, figs. 1–3, text-fig. 20–23; Burton, 1930, p. 669.

Occurrence.—Low Isles, the Thalamita Flat.
Remarks.—The colour of the specimen in life is recorded as gamboge.
Distribution.—Australia (south-west coast); Gulf of Manaar.

Genus *Polymastia*, Bowerbank.

Polymastia megasclera, sp. n. (Text-fig. 14.)

Holotype.—B.M. 30.8.13.155.
Occurrence.—Low Isles, the Thalamita Flat and Mangrove Park.
Diagnosis.—Sponge irregular, low-growing and massive, bearing numerous, irregularly distributed, wart-like papillae on upper surface; texture tough, incompressible; surface even, coarsely pilose; colour, in spirit, brown externally, papillae and choanosome flesh-coloured, cortex white; skeleton composed of radial bundles of long tylostyli, with tylostyli of various sizes scattered profusely in choanosome, a sub-cortical tangential layer of short, slender tylostyli and a cortical palisade of tylostyli of various sizes, but composed mainly of stout, fusiform tylostyli; spicules of three main types, long tylostyli of radial bundles, ·9 by ·02 mm., short, slender tylostyli, varying from ·24 to ·44 by ·008 mm., and stout fusiform tylostyli, ·6 by ·032 mm.

Remarks.—The holotype is a spreading mass 8 cm. by 6 cm. across by 1 cm. thick, bearing small papillae barely raised above the surrounding surface.

The skeleton is fairly typical, being composed of radial bundles of long tylostyli, with shorter tylostyli scattered between, a tangential layer and a palisade of short tylostyli. The tylostyli scattered in the choanosome are so numerous, so variable in size, and include so many developmental and intermediate forms, that it is not easy to tell precisely how many different types are present. The small slender spicules usually have a well-developed head, often with annular swellings, while annular swellings are commonly found in both the long and slender and in the fusiform tylostyli (*cf.* Text-fig. 14*d*). A second, very small, specimen differs in having a non-pilose surface.

In addition to its peculiar external form, the species differs from all other species in the shape of the fusiform styli which make up the larger part of the cortical palisade.

Family Tethyadae.

Genus *Tethya*, Lamarck.

Genolectotype.—*T. lyncurium*, Lamarck (*fide* Topsent, 1920, pp. 640–646).

Tethya, Lamarck, 1815, p. 69 ; *Tethia*, Lamarck, 1816, p. 384 ; *Tethium*, Blainville, 1830, p. 507 ; *Donatia*, Nardo, 1833, p. 522 ; *Lyncuria*, Nardo, 1834, p. 715 ; *Tethea*, Siebold, 1843, p. 363 ; *Tethyum*, Lieberkühn, 1859, p. 522 ; *Amniscos*, Gray, 1867, p. 542 ; *Columnitis*, Schmidt, 1870, p. 25 ; *Alemo*, Wright, 1881, p. 15.

Remarks.—Scudder attributes the genus *Tethya* to Oken, who used the name in 1815, but according to Sherborn (Index Animalium) it had already been used by Lamarck.

Tethya robusta (Bowerbank).

(For synonymy see Burton, 1924, p. 1037, under *Donatia robusta*).

Occurrence.—Low Isles, the Thalamita Flat.
Distribution.—Indian Ocean ; Malay Area ; Australia (all coasts).

Tethya japonica, Sollas.

T. japonica, Sollas, 1888, p. 430, pl. xliv, figs. 7–14 ; *Donatia japonica*, Burton, 1924, p. 1039.

Occurrence.—Stn. XIX, 10th March, 1929 : $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell gravel.
Distribution.—Malay Area ; Indian Ocean.

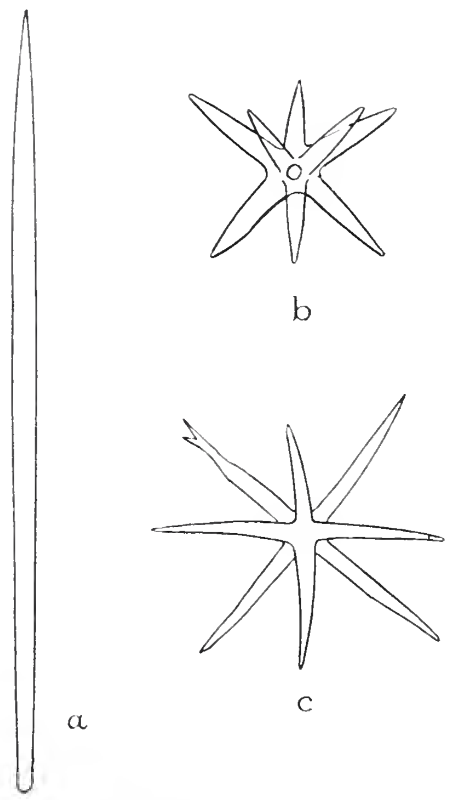
Genus *Tethyorrhaphis*, Lendenfeld.

Tethyorrhaphis oxyaster, sp. n. (Text-fig. 15.)

Holotype.—B.M. 30.8.13.30.
Occurrence.—Stn. IV, 24th November, 1929 : Linden Bank, 38 fath., mud.
Diagnosis.—Sponge of usual form and anatomy ; megascleres styli, widest at centre and narrowing gradually to a rounded proximal end, up to 1·12 by ·024 mm. ; megasters of 2 sorts, cortical spherasters with slight centrum and 10–12 stout, smooth rays, variable in size up to ·12 mm. in diameter, and choanosomal oxyasters, with smooth, often curved rays, 8–12 in number, without centrum, varying in diameter from ·02–·2 mm. ; micrasters absent, but spirasters, often bearing lateral branches and measuring ·018 by ·003 mm. are present.

Remarks.—The species differs from the only other known species, *T. laevis*, Lendenfeld (see Burton, 1924, p. 1043), in the absence of micrasters, and in the shape and size of the megasters. In all other respects they agree closely. The third microsclere has been called hitherto a microrhabd, on the assumption that the Tethyadae belonged to the Astrotetraxonida. The fact that this microsclere is not a microrhabd but a true spiraster, settles emphatically the much-debated question of the systematic position of the family, which is here placed next to the Clavulidae.

The characteristic feature of the present species, apart from the absence of micrasters, is the presence of two closely similar forms of megaster, the one exclusively cortical and the other choanosomal. A typical cortical megaster has a centrum ·024 mm. in diameter, and the rays are ·012 mm. thick at the base. In the choanosomal megaster there is no centrum, and the rays measure, in the larger examples, ·12 mm. long by ·008 mm. thick at the base.



TEXT-FIG. 15.—Spicules of *Tethyorrhaphis oxyaster*, sp. n. *a*, Style, × 100; *b*, cortical megaster, and *c*, choanosomal megaster, both × 130.

Family CLAVULIDAE.

Genus *Timea*, Gray.

Timea stellata, (Bowerbank).

Hymedesmia stellata, Bowerbank, 1866, p. 150; *idem*, 1874, p. 71, pl. xxviii, figs. 5–8; *Timea stellata*, Gray, 1867, p. 544; *Hymedesmia stellata*, Bowerbank, 1882, p. 67; Topsent, 1900, p. 114, pl. iii, fig. 15; *Stelligera stellata*, Babić, 1922, p. 270, fig. L.

OCCURRENCE.—Stn. XXV, 17th March, 1929: In Papuan Pass, 20–25 fath., foraminifera and coral fragments.

REMARKS.—The species is here recorded from extra-European waters for the first time. The specimen, which forms a thin crust on *Thorectopsamma irregularis*, sp. n., is quite typical.

DISTRIBUTION.—Europe (coasts of British Isles, France and Mediterranean Sea).

Genus *Spirastrella*, Schmidt.

The laudable attempt by Vosmaer (1911) to reduce the number of specific names applicable to the genus *Spirastrella* and to demonstrate that a large number of so-called species are merely growth forms of other species has already been criticized by Topsent (1918) on the grounds that the subordination of specific names was carried too far. It is conceivable that Vosmaer may eventually be proved to have been correct in his action, but, while it cannot be denied that his work was a step in the right direction, the specimens of *Spirastrella* present in the Great Barrier Reef collections suggest that in some respects at least his conclusions require modification. These specimens, to the number of 31, appear to be divisible among three distinct species, and, so far as this collection is concerned, in all cases a particular external form is associated with a definite set of spicular characters. For the time being, therefore, I propose to regard them as representing distinct species without inquiring more closely into the very much wider problem of the fate of the remaining species of the genus.

Of the three species of *Spirastrella* represented on the Great Barrier Reef, two at least may be shown to be boring sponges in the early stages. Certainly the perforation of the coral fragments in which they are found is of a very simple type, and contrasts strikingly with the labyrinthine nature of the canals and chambers of *Cliona*, yet the similarity between the skeletons of *Spirastrella* and *Cliona* suggest that, at the very least, these two genera should not be assigned to different families as has hitherto been the custom.

Spirastrella inconstans (Dendy).

Suberites inconstans, et varr. *maeandrina, digitata, globosa*, Dendy, 1887, pp. 154–157, pls. ix, x.

Occurrence.—Batt Reef; Low Isles, Crab Spit, Mangrove Park, and between Madrepore Moat and Mangrove Park. Stn. XXII, 11th March, 1929: to E. of Snake Reef, 13½ fath., mud, with foraminifera and shell. Stn. XXIII, 12th March, 1929: in lee of Turtle Is., 8 fath., mud and shell.

Remarks.—Of the twenty specimens assigned to this species, 10 are very like the type of *Suberites inconstans*, var. *globosa*, in external appearance and almost identical with specimens S.E.612d and S.E.98 (of tropus *glaebosa*, Vosmaer, 1911, pl. i, figs. 3–4). The symbiotic barnacles are present in considerable numbers in each specimen, and the skeleton is composed of a coarse-meshed isodictyal network of tylostyli. The microscleres are slender spinispirae* measuring up to ·035 mm. long (even to ·07 in one specimen). Six of the remaining specimens are typical examples of *S. inconstans*, var. *digitata*, having the same type of skeleton as the var. *globosa*, but showing a marked diminution in the number of cirripedes present in the dermal regions. Of the remainder, three are intermediate in form between the varieties *globosa* and *digitata*, but agree in all other respects, except for some variation in the number of cirripedes present.

The last specimen corresponds closely anatomically with all the others, but has the external form of *Spirastrella aurivillii*, var. *excavans*, Lindgren, a single stout papilla perforating coral limestone. From this specimen it appears that *S. inconstans* (Dendy)

* It is worth mentioning that spinispirae are abundantly present in the type of *S. inconstans*, var. *globosa*, although Dendy failed to remark them.

may pass through a boring stage in early life, and that the whole life-history is similar to that of *Cliona celata* or any other of the typical boring sponges.

DISTRIBUTION.—Indian Ocean.

Spirastrella aurivillii, Lindgren.

S. aurivillii, et varr. *excavans, libera*, Lindgren, 1897, p. 484; 1898, p. 40, pl. xvii, fig. 11; pl. xviii, fig. 4; pl. xix, fig. 22.

OCCURRENCE.—Low Isles, the Thalamita Flat.

REMARKS.—The five specimens agree with *Spirastrella aurivillii*, var. *excavans*, in all respects and a sixth agrees equally with the var. *libera*. There can, therefore, be little doubt that they represent stages in a boring *Spirastrella* very similar in habitus to *S. inconstans* (Dendy).

DISTRIBUTION.—Java.

Spirastrella semilunaris, Lindgren.

S. semilunaris, Lindgren, 1897, p. 484; 1898, p. 41, pl. xix, fig. 23.

OCCURRENCE.—Stn. XXII, 11th March, 1929: to east of Snake Reef, $13\frac{1}{2}$ fath., mud, with foraminifera and shells. Stn. XXIII, 12th March, 1929: in lee of Turtle Is., 8 fath., mud and shell.

REMARKS.—The four specimens all have the form of S.E.1945 (Vosmaer, 1911, pl. iii, fig. 2) and the spiculation of *S. semilunaris*, Lindgren.

DISTRIBUTION.—Java.

Comparison of the Main Characters of the Species of Spirastrella *found on the Great Barrier Reef.*

	inconstans.	aurivillii.	semilunaris.
Form	Massive with conspicuous oscules, often digitate with deep cloacae	Boring, with flattened papillae lying almost level with substratum, or digitate. Oscules at ends of papillae	Creeping and agglutinating, incorporating numerous foreign bodies in its substance. Oscules not seen.
Skeleton	Coarse, multispicular, isodictyal	Densely-packed halichondroid	Loosely arranged, mainly scattered spicules.
Megascleres	Slender	Stout	Slender.
Microscleres	Slender, beset with small, wart-like tubercles	Slender, bearing long processes	Stout and short, with conical rays.
Symbionts	Present	Absent	Absent.
Colour, in spirit	Brick-red usually	Purplish	Brown.

Order KERATOSA.

Family Spongiidae.

Genus *Phyllospongia*, Ehlers.

Genotype.—*Spongia papyracea*, Esper.

Diagnosis.—Spongiidae with skeleton of slender pithed fibres, of pale-coloured spongin, arranged in a sub-isodictyal network; without foreign inclusions in fibres and without sandy cortex.

Remarks.—The genus *Phyllospongia* was originally established by Ehlers (1870, p. 22) for *Spongia papyracea*, Esper, but has gradually undergone corruption until now it is merely a receptacle for all soft-fibred horny sponges of flabellate or cup-shaped form. The major fault lies with Lendenfeld (1889), who treated the genus in the most unconventional way possible, and in order to unravel the present tangle it will be necessary to begin with his work.

Lendenfeld divided the genus into three sub-genera: (1) *Antheroplax*, (2) *Spongionella*, and (3) *Carterispongia*. The first of these was a new name proposed for a group of species which included *Geelongia vasiformis*, Carter, and as *Geelongia* is a valid generic name, and has priority, *Antheroplax* must be considered a synonym of it. *Spongionella* was established by Bowerbank (1866, p. 359) for *S. pulchella*, since re-described by Topsent (1929, pp. 1–12). *Carterispongia* (*errore Carteriospongia*), Hyatt (1877, p. 541), includes, as the first species, *Spongia otahitica*, Esper, which is synonymous with *Spongia foliascens*, Pallas (1766, p. 395). *S. foliascens*, Pallas, is therefore accepted here as the genolectotype of *Carterispongia*, Hyatt. *Spongia papyracea*, Esper, the true type of *Phyllospongia*, is relegated by Lendenfeld to the subgenus *Spongionella* without comment.

The genus *Phyllospongia*, with *Spongia papyracea*, Esper, as genotype, is characterized by a skeleton of slender pithed fibres of pale-coloured spongin which form an irregularly isodictyal skeleton. There are no sandy inclusions in the fibres or in the cortex. The genus *Carterispongia* is without a type-specimen. Pallas's description is fairly complete, but no figure is given, and under these conditions it will be necessary to choose a neotype. For this purpose I take the specimen B.M. 25.11.1.411 from Coin Peros, Indian Ocean. This is practically identical in form with the specimen figured by Lendenfeld (1889, pl. v, fig. 3) under the name *Phyllospongia foliascens*, conforms well to the accepted conception of the species and is from the type-locality. Its skeleton consists of fibres of the same type as those found in *Spongia papyracea*, Esper, but many of them, usually those running vertically to the surface, are cored with sand-grains. The meshes of the skeleton are also much more irregular and there is a sandy layer at the surface. Whether it will be possible to maintain the distinction between *Phyllospongia* and *Carterispongia* remains to be seen, but there is sufficient justification for regarding them as distinct for the time being.

The genus *Mauricea* is very like *Carterispongia*, but the foreign inclusions in the fibres are few and sparsely scattered and there is only a very slight layer of sand at the surface. It may, however, be necessary to unite the two genera.

The genus *Geelongia* may be best described as a *Spongionella*, in which there is a thick sandy cortex and in which the primary fibres are cored by sand.

Actually, *Geelongia* (syn. *Antheroplax*) and *Spongionella* have much in common, while the same may be said of *Carterispongia* and *Phyllospongia*, but these two pairs of genera belong to totally different divisions of the Keratosa. Similarly, the various species included by Lendenfeld under his comprehensive heading of *Phyllospongia* are of a most diverse order, having this only in common, that they are flabellate or cup-shaped in form.

Phyllospongia dendyi, Lendenfeld.

P. dendyi, varr. *frondosa* et *digitata*, Lendenfeld, 1889, p. 177, pl. xiv, fig. 5.

Occurrence.—Batt Reef or Low Isles.

Remarks.—The present specimen is intermediate between the vars. *frondosa* and *digitata* described by Lendenfeld, and, since these two varieties were founded on unessential characteristics, this subdivision of the species is not accepted here.

Distribution.—Australia (west coast).

Genus *Carterispongia*, Hyatt.

Genolectotype.—*Spongia foliascens*, Pallas.

Diagnosis.—Skeleton of slender, pithed fibres of pale-coloured spongin arranged in a very irregular network; ascending fibres cored by foreign inclusions; dermis strengthened by a layer of foreign *débris*.

Carterispongia foliascens (Pallas).

Spongia foliascens, Pallas, 1766, p. 395; *Phyllospongia foliascens*, Lendenfeld, 1889, p. 196, pl. v, fig. 3; pl. vi, figs. 1, 3, 4, 10; pl. vii, fig. 11; pl. xiv, fig. 2; pl. xxiv, fig. 6; *Phyllospongia foliascens*, Topsent, 1897, p. 483; *Carteriospongia otahitica*, Keller, 1889, p. 302; (for further synonymy see Lendenfeld, *l. c.*).

Occurrence.—Low Isles and Batt Reef.

Distribution.—Red Sea; Indian Ocean; Malay Area; Australia* (all coasts); New Zealand*; Tropical Pacific.*

Carterispongia vermicularis (Lendenfeld).

Phyllospongia vermicularis, Lendenfeld, 1889, p. 201, pl. xv, fig. 5.

Occurrence.—Stn. XIX, 10th March, 1929: about $\frac{1}{2}$ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*.

Remarks.—The single specimen is not in a good state of preservation, which makes its identification a little difficult. It consists of a sub-clathrous mass of branches having the appearance of *Carterispongia vermicularis*, as figured by Lendenfeld (*loc. cit.*). At the same time, the branches in the type measured only 2 mm. in diameter, whereas those of the present specimen measure up to 10 mm. On the other hand, they agree in the structure of the skeleton. Direct comparison is not possible since, although Lendenfeld

* (*Fide* Lendenfeld, *l. c.*)

has indicated its presence in the British Museum collection, careful search has failed to reveal the type-specimen.

DISTRIBUTION.—Australia (west coast).

Carterispongia clathrata (Carter).

Hircinia clathrata, Carter, 1881, p. 366; *Hyatella** *clathrata*, Lendenfeld, 1889, p. 115, pl. xii, figs. 15, 16; pl. xx, fig. 4; *Hircinia clathrata*, Dendy, 1889, p. 96.

OCCURRENCE.—Stn. XXII, 11th March, 1929: E. of Snake Reef, $13\frac{1}{2}$ fath., mud, with foraminifera and shells. Stn. XXIII, 12th March, 1929: Turtle Is., 8 fath., mud and shell.

REMARKS.—This is apparently the first occasion on which specimens of this species preserved in alcohol have been examined, and it is quite evident that the species should not be included in *Hircinia*. Neither the holotype nor Lendenfeld's specimens are available for examination, but as neither Carter nor Lendenfeld mention the presence of filaments, it must be presumed that these are absent, as they certainly are in Dendy's specimens and those from the Barrier Reef.

DISTRIBUTION.—Indian Ocean; Australia; West Indies (*fide* Lendenfeld, *loc. cit.*).

Genus *Spongia*, Linnaeus.

Spongia, Linnaeus, 1759, p. 1348; *Euspongia*, Bronn, 1859, p. 22; *Ditela*, Schmidt, 1862, p. 24; *Hippospongia*, Schultze, 1879, p. 614.

DIAGNOSIS.—Spongiidae with skeleton of pale-coloured, slender spongin fibres, differentiated into primary fibres, running vertically to surface, connected by a complicated and irregular network of secondary fibres free from inclusions.

REMARKS.—Although the Bath sponge was the first to be recognized and named, and is the one most quoted in our literature, it is unusually difficult to choose a specimen

* The genus *Hyatella* was established by Lendenfeld (1889, p. 102) who diagnosed it: Aulenidae which consist of a reticulating lamella with large vestibular cavities, which are more extensive than the septa between them. The thicker connecting fibres of the skeleton are over 0·03 mm. thick. The meshes of the skeleton net over 0·2 mm. wide. Mostly hard and incompressible sponges.

This diagnosis does not contain a single feature by which the genus could be recognized with any degree of certainty. Nor is it possible to glean, from the characters of the various species assigned to it, what Lendenfeld's conception of the genus may have been, since these are all inadequately described and the few of them that can be recognized, or are available for examination, belong obviously to several different genera. When we come to the question of the genotype, the situation is no better. Lendenfeld says (*l. c.*, p. 102): "The first described sponge referable to this genus is the *Spongia sinuosa* of Pallas . . ." This leaves little doubt as to what he considered to be the type of the genus, but, unfortunately, although several authors have identified sponges with *Spongia sinuosa*, Pallas, I fail to see any possibility of recognizing this species.

Pallas's description of *Spongia sinuosa* reads: "Incrustat varia corpora, semipollicari circiter strato; interna crustae facies poris coecis inaequalibus sparsa, exterior cavitatibus majusculis, oblongis vel cotyloidcis, confertissimis obsita. *Substantia* tenaciuscula, mollis, griseo-flavescens, ex fibris maxime perpendicularibus, per creberrimas anastomoses tenerioresque fibrillas contextis, facta. Crustarum margo tenuiter veli instar diffunditur & sensim crassescit atque cavernosus fit. *Odor* combustae animalis. *Locus:* Oceanus Indicus ? "

It is impossible to recognize anything by this! The genus must therefore be treated as unrecognizable and the use of the name *Hyatella* abandoned.

which shall represent the type of the species. Since 1758, when Linnaeus first used the name for what is known, in a loose and indefinite way, as the Bath Sponge, the species has been again mentioned by Linnaeus (1767), and by Pallas (1766), Houthuyn (1772), Ellis and Solander (1786), Gmelin (1789) and Esper (1794). In one case only is the specimen assigned to this species now available, namely, that described by Esper, and this was subsequently made the type of *Spongia adriatica*, var. *quarnerensis*, by Ehlers (1870). This specimen is now preserved in the Museum at Erlangen. The position is rendered more complicated by the fact that all authors subsequent to Esper have given either a casual reference to the species only, or have assigned the specimens before them to one or other of the numerous varieties of the species now recognized. Under the circumstances, it seems that no one specimen can be said more than any other to represent that elusive animal, the Bath Sponge, and no one can be regarded, more than any other, as the type of the species. One of two alternatives must therefore be adopted: either to abandon the name altogether or choose a neotype. The first is inadvisable as the name is so well-known, and, as regards the second course, the obvious thing would be to select Esper's specimen as the neotype. Since, however, accessibility for examination is an important factor, and there are obvious difficulties in the way of this if Esper's specimen be chosen, and as a matter purely of convenience, I select a specimen named by Schulze, *S. officinalis*, var. *adriatica*, and deposited in the British Museum (No. 83.12.4.28) as the neotype of *S. officinalis* and the lectotype of var. *adriatica*. The var. *adriatica* becomes therefore the typical variety of *S. officinalis*.

The neotype thus chosen has a skeleton conforming with the accepted ideas of the diagnosic features of the species *S. officinalis*, and expressed in the diagnosis of the genus *Spongia* given above. There can therefore be little objection to accepting this specimen as the type of the species, and, on the other hand, there is great advantage to be gained, in that, for the first time in its history, the species is placed on a definite and stable basis.

A similar difficulty is encountered in determining the type of *Hippospongia*. This genus was established by Schulze (1879, p. 614) for *Spongia equina*, Schmidt (1862, p. 23), and the original specimen (or specimens ?) is, so far as may be ascertained, not to be found. Under the circumstances, I choose a specimen in the British Museum, agreeing very closely in external characters with that figured by Schulze (*loc. cit.*, pl. xxxv, fig. 14). This has a skeleton agreeing in all respects with that of the neotype of *Spongia officinalis*. The genera *Spongia* and *Hippospongia* must thus be regarded as synonyms. This is an eminently satisfactory conclusion as no author in the past seems to have been sure of the exact value of the two genera.

Thus, it is not unusual to find a species placed first in *Spongia* (= *Euspongia*) and then in *Hippospongia* (*cf.* Lendenfeld, 1889, pp. 300–325, where this is well illustrated). In other cases, one species has been consistently placed in *Spongia*, while another species, which in actual fact is at most only varietally distinct from it, has been as consistently placed in *Hippospongia*.

The only attempt made to diagnose and compare the two genera under discussion is that contained in Lendenfeld's Monograph (1889, pp. 245 and 280). Here the genus *Euspongia* (= *Spongia*) is diagnosed: "Massive Spongidae with distinct main, and branched, continually anastomosing connecting fibres. The meshes of the connecting fibre net are mostly under 0·04 mm. wide. The surface is conulated and destitute of

a dense cortex. Vestibular cavities absent or small." The genus *Hippospongia* is diagnosed: "Spongidae consisting of reticulate lamellae between which extensive vestibular lacunae are situated. These are wider than the septa between them and are thick. The connecting fibres form a network with meshes 0·1–0·4 mm. wide. The dry skeletons of the wide-meshed species are soft and elastic."

The first expresses the usually accepted conception of the genus *Spongia*, in so far as this could hitherto have been defined, and the latter is quite clearly based on Schulze's figure of *Hippospongia equina* (Schmidt). After due allowance is made for the obvious defects in the construction of Lendenfeld's diagnoses, we are left with the impression that the only difference between *Spongia* and *Hippospongia* is the more cavernous design of the internal skeleton of the latter, and this, far from being of generic importance, is a character of doubtful value in the determination even of varieties or of a species. How little Lendenfeld was guided by his own diagnoses is shown by a casual examination of the species he assigns to the two genera.

The name *Euspongia* was proposed by Bronn (1859, p. 22) to replace *Spongia*, but no explanation was given either then or subsequently, by this or any other author, as to the reason for such a change, although it has been almost universally accepted. So far as may be judged, the objection to using the name *Spongia* lies in the fact that it means literally a sponge, and that we can no more have this than we could have a genus of birds named *Aves*. If that were so, then it is impossible to imagine that the case is met by rejecting a name meaning "a sponge" and substituting one meaning "a true sponge", and since it is contrary to accepted procedure to change a name once given, I propose to revive the use of the word *Spongia*. Vosmaer's suggestion, that "Es ist zweifelsohne besser den Namen *Spongia* fallen zu lassen, da er für sehr verschiedene Schwämme in Anwendung gebracht ist", is indefensible.

Ditela, Schmidt (1862, p. 24, pl. ii, fig. 6), with genotype *D. nitens*, is also a synonym of *Spongia*, as shown by a preparation in the British Museum collection, from the type. The secondary reticulation figured by Schmidt is formed, obviously, by the dried strands of sarcode.

Spongia officinalis, Linnaeus.

Occurrence.—Mangrove Park, Low Isles and Batt Reef.

Remarks.—Judging by the range in form shown by the numerous specimens of commercial sponges in the British Museum collection, including between 400 and 500 individuals presented to the British Museum by Mr. L. R. Crawshay, it seems probable that we shall ultimately recognize one species only, *S. officinalis*, and that this species will be divisible into a number of ill-defined tropi, like those of *Spirastrella purpurea*, recognized by Vosmaer (1911). Since, however, it is hoped that Mr. Crawshay will soon publish his observations on the sponges of the West Indies and since an opinion on this material can only realize its greatest value in conjunction with observations made in the field, I do not propose to consider the Crawshay collection any further here.

The Barrier Reef specimens here assigned to *S. officinalis* are of two forms, which I propose to call α and β respectively. The first, represented by numerous specimens, is spherical or subspherical in form with numerous oscules on the upper surface, and the second is represented by a single bi-ridged specimen.

Form α (= *Euspongia irregularis*, var. *pertusa*, Lendenfeld, see Stephenson, 1931) resembles closely in form and texture the Bahamas Reef Sponge and is, in my opinion, not even varietally distinct from it. It is, moreover, identical with *E. officinalis*, var. *ceylonensis*, Dendy, *E. trincomaliensis*, Lendenfeld, and *E. officinalis*, var. *arabica*, Keller.

Form β approximates closely, in surface structure and texture, to the West Indian Grass Sponge (= *Hippospongia equina* (Schmidt)), but in form agrees very nearly with *Hippospongia canaliculata*, Lendenfeld. There is, too, a resemblance to the Cuban Hard Head (= *H. equina*). On the other hand, except in form, it does not differ greatly from form α, and is obviously congeneric with it and certainly conspecific even when judged by the standard set in Lendenfeld's monograph.

From the Crawshay collections referred to above, it seems certain that the variability of the form in commercial sponges is far greater than has been hitherto suspected, in which case the Australian sponge is identical with the West Indies form. This connection between the faunas of Australia and West Indies has been commented on elsewhere (p. 514).

DISTRIBUTION.—Australia ; Indian Ocean ; Malay Area ; West Indies.

Spongia nardorus (Lendenfeld).

Aphrodite nardorus, Lendenfeld, 1886, p. 306, pl. xxxv, figs. 24–26 ; *Hippospongia aphroditella*, *idem*, 1889, p. 312, pl. xi, figs. 11–14 ; pl. xii, fig. 13 ; *Ceratodendron haeckelii*, Marshall, 1892, p. 5, pls. ii, iii, pl. vi, figs. 8–15 ; pl. vii, fig. 1.

OCCURRENCE.—Stn. XIX, 10th March, 1929 : about ½ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*. Stn. XXI, 11th March, 1929 : ½ mile N.W. of Howick Is., 10 fath., mud and shell, foraminifera. Stn. XXII, 11th March, 1929 : E. of Snake Reef, 13½ fath., mud, foraminifera, and shell. Stn. XXIII, 12th March, 1929 : in lee of Turtle Is., 8 fath., mud and shell

DISTRIBUTION.—Australia (Torres Straits and Bass Straits).

Thorectopsamma, gen. n.

GENOTYPE.—*T. irregularis*, sp. n.

DIAGNOSIS.—Spongiidae with laminated fibres completely filled with sand-grains, or other foreign matter ; skeleton a regular reticulation of quadratic mesh, with secondary fibres only slightly smaller than primary fibres ; spongin dark-coloured ; no special dermal skeleton.

REMARKS.—The genus appears to be closely related to *Thorecta*, *Thorectandra* and *Spongionella*, and is accordingly placed in the family *Spongiidae* following the usage of Lendenfeld (1889). The characteristic feature of *Thorectopsamma* is that all fibres are densely packed with sand-grains, whereas in the three genera mentioned the fibres contain either no foreign matter at all, or a line of sand-grains coring the primary fibres only.

Thorectopsamma irregularis, sp. n.

HOLOTYPE.—B.M. 30.8.13.217.

OCCURRENCE.—Stn. XXV, 17th March, 1929 : In Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Diagnosis.—Sponge irregularly massive; surface conulose, conuli 1 mm. high and 1–2 mm. from each other; oscules not seen; colour, in spirit, black on upper parts, shading to drab below; meshes of skeleton ·6 to 1·6 mm. across, primary fibres ·2 mm. thick, secondary fibres ·12 mm. thick.

Remarks.—There is nothing remarkable about the external form of this species, but the skeleton is interesting. The fibres are so densely charged with sand-grains that in most places it is impossible to determine their structure. At several points, however, the fibre is, for a short interval, free of inclusions and the laminated character becomes visible, and this, and the regularity of the skeleton as a whole, suggests that *Thorecto-psamma* is a *Thorecta* in which the whole of the fibre is filled with foreign matter.

Genus *Hircinia*, Nardo.

Genolectotype.—*I. spongiastrum*, Nardo.

Ircinia (*vel Jrcinia*), Nardo, 1833, col. 521; *Hircinia*, Nardo, 1834, p. 714; *Stematumenia*, Bowerbank, 1845, p. 406; *Filifera*, Lieberkühn, 1859, p. 370; *Sarcotragus*, Schmidt, 1862, p. 35; *Polytherses*, Duchassaing and Michelotti, 1864, p. 67; *Euricinia*, Lendenfeld, 1889, p. 554; *Hircinella*, *idem*, *l. c.*, p. 564; *Dysidicinia*, *idem*, *l. c.*, p. 565; *Psammocinia*, *idem*, *l. c.*, p. 579.

Diagnosis.—Spongiidae with skeleton of pithed fibres differentiated into primary fasciated systems of fibres, often filled with foreign inclusions, connected by transverse or irregularly-disposed secondary fibres; interstices of skeleton filled to a greatly varying extent with "filaments".

Remarks.—The genus *Ircinia* was established by Nardo (1833) for *I. spongiastrum* and three other species, the types of which appear to be lost; but the original diagnosis of the genus leaves no doubt that it was intended for those sponges with a horny skeleton, the larger fibres of which are fasiculated, and spongin filaments. The genera *Filifera*, Lieberkühn, and *Stematumenia*, Bowerbank, the descriptions of which are accompanied by figures, must therefore be regarded as identical with it. Later, Nardo (1834, p. 714) altered the spelling to *Hircinia*, which is classically more correct, and since this form has been accepted by subsequent authors, there is no reason why it should not continue to be used.

The following names fall into synonymy with *Hircinia*: *Polytherses*, Duchassaing and Michelotti, and *Euricinia*, *Hircinella*, *Dysidicinia* and *Psammocinia*, all of Lendenfeld. In spite of the absence of filaments from the genoholotype, *Sarcotragus*, Schmidt, must also be so treated (*cf. I. dendroides*, p. 580).

Hircinia irregularis (Poléjaeff).

Cacospongia irregularis, Poléjaeff, 1884, p. 63, pl. vi, fig. 10; pl. viii, fig. 5; *Hircinia gigantea*, Lendenfeld, 1889, p. 588, pl. xxvii, fig. 7; pl. xxviii, fig. 2; pl. xxxvi, figs. 1, 6, 10.

Occurrence.—Stns. II and III, 24th November, 1928: Linden Bank, 28 fath., shell and sand. Stn. XIX, 10th March, 1929: about ½ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*.

Remarks.—The specimens agree closely with the holotype in all respects. Those recorded from Port Jackson as *Hircinia gigantea*, which are now in the British

Museum collection, are conspecific with *H. irregularis* (Poléjaeff), but they are much larger and have more prominent conules.

DISTRIBUTION.—Australia (north and east (?) coasts).

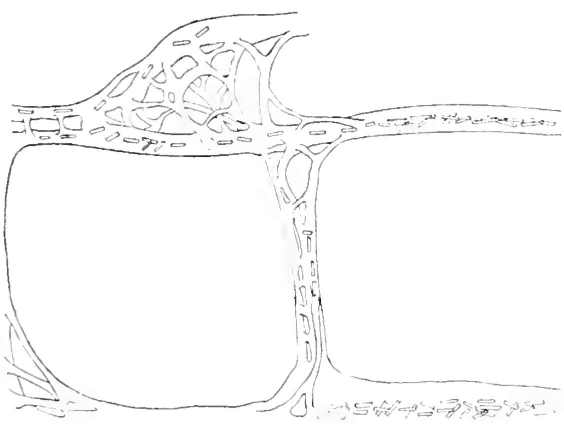
Hircinia echinata, Keller.

H. echinata, Keller, 1889, p. 347, pl. xxi, fig. 13; *H. variabilis*, var. *hirsuta*, Row, 1911, p. 372.

OCCURRENCE.—Stn. XIX, 10th March, 1929: about ½ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*.

REMARKS.—A sub-spherical specimen, 11 cm. in diameter, agrees closely with Keller's description of *H. echinata*. The present specimen is conspecific with Row's *Hircinia variabilis*, var. *hirsuta*, from the Red Sea, of which I have examined the type. The identity of *H. variabilis*, var. *hirsuta*, with *H. echinata*, Keller, would thus appear to be well established, although not checked by comparison with the type-specimen of the latter.

DISTRIBUTION.—Red Sea.



TEXT-FIG. 16.—*Hircinia ramosa*, Keller. Section at right angles to surface. × 52.

Hircinia ramosa, Keller. (Plate I, fig. 11; Text-fig. 16.)

H. ramosa, Keller, 1889, p. 345, pl. xx, fig. 5; Row, 1911, p. 372.

OCCURRENCE.—Stn. XIX, 10th March, 1929; ½ mile N. of Eagle Is., 10 fath., shell, gravel, rich *Halimeda*.

REMARKS.—The specimen agrees closely with the holotype and with Row's specimen.

Row's observation that the skeleton of his specimen "is quite free from foreign bodies" is wrong. Spicule fragments are present in the fibres, but not in such numbers as in the Barrier Reef specimen. Text-fig. 16 shows the peculiar clathrous structure commonly seen in both primary and secondary fibres.

DISTRIBUTION.—Red Sea.

Hircinia pinna, Hentschel.

H. pinna, Hentschel, 1912, p. 443, pl. xv, fig. 4; pl. xvi, fig. 5.

OCCURRENCE.—Stns. II and III, 24th November, 1928: Linden Bank, 28 fath., shell and sand.

DISTRIBUTION.—Aru Island.

Hircinia aruensis, Hentschel.

H. aruensis, Hentschel, 1912, p. 445, pl. xvi, fig. 6.

Occurrence.—Stn. XXIV, 13th March, 1929 : ¾ mile N.E. of Pasco Reef, 16½ fath., hard and shelly bottom.

Distribution.—Aru Island.

Hircinia ramodigitata, sp. n. (Plate I, fig, 12 ; Text-fig. 17.)

Holotype.—B.M. 30.8.13.219.

Occurrence.—Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., rock and shell gravel.

Diagnosis.—Sponge ramo-digitate ; surface conulose ; oscules few, 2 mm. diameter, dispersed ; texture compressible ; colour, in spirit, drab ; skeleton a reticulation of primary and secondary fibres ; primary fibres simple, cored with sand-grains and sponge spicules ; secondary fibres simple or forming an irregular network, rarely containing foreign inclusions ; filaments absent ; dermis containing a reticulation of polygonal mesh formed of sand and spicules.

Remarks.—The external form of the species is shown sufficiently well on Plate I, fig. 12, to obviate the need for further description, and Text-fig. 17 gives a tolerably clear idea of the structure of the skeleton. The distance between adjacent primary fibres is variable within fairly wide limits, making the surface conuli irregular in distribution. The secondary fibres may be simple, or may form an irregular network by branching and anastomosis. Foreign inclusions are confined almost entirely to the primary fibres, only an occasional sand-grain or piece of spicule being found in the secondaries. The primary fibres average ·096 mm. thick and the secondaries ·048 mm. Filaments are absent, but the choanosome is filled with a filamentous alga which simulates the appearance of the "*Hircinia*-filaments".

There is no well-marked dermal skeleton, but the dermis contains a polygonal reticulation of sand-grains and fragments of spicules which, in some places at all events, appear to be held in place by a coating of spongin of so pale a colour as to be almost inappreciable.

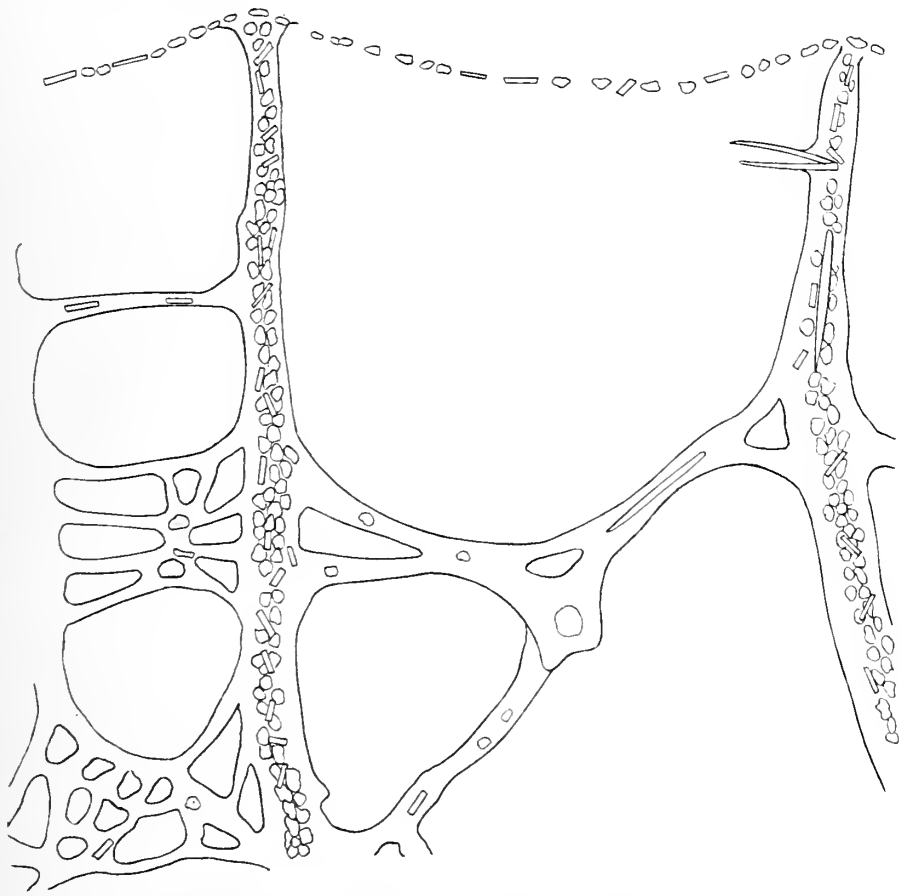
Although filaments are absent, the species has been assigned to *Hircinia* owing to its likeness in all other respects to *H. variabilis* (Schulze). In external form and the structure of the fibres of the skeleton, the holotype of *H. ramodigitata*, sp. n., is singularly like a specimen of *H. variabilis* from Trieste, B.M. 83.12.4.23, identified by Schulze, but the sand in the dermis in Schulze's specimen is not arranged in a reticulation as in the present species, and the secondary fibres form a more clearly marked network.

Hircinia dendroides (Poléjaeff).

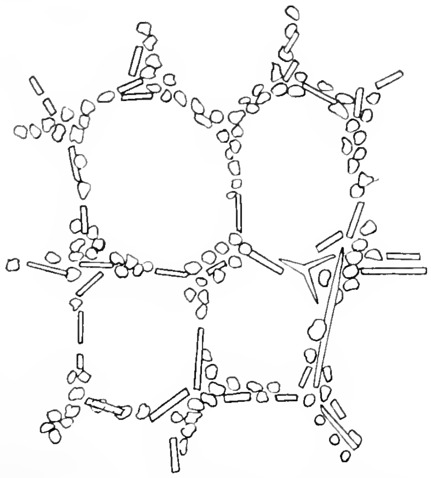
C. dendroides, et varr. *dura, friabilis*, Poléjaeff, 1884, p. 60, pl. viii, figs. 1–3 ; pl. vi, fig. 14 ; *Hircinia schulzei*, Dendy, 1905, p. 221, pl. xvi, fig. 3.

Occurrence.—Stn. X, 22nd February, 1929 : Satellite Reef, 14–17 fath., coral, shell, gravel and mud. Stn. XXI, 11th March, 1929 : ½ mile N.W. of Howick Is., 10 fath., mud and shell. Stn. XXIII, 11th March, 1929 : Turtle Is., 8 fath., mud and shell. Stn. XXV, 17th March, 1929 : Papuan Pass, 20–25 fath., foraminifera and coral fragments.

Stn. XXVII, 18th March, 1929: Papuan Pass, 17 fath., coarse sand. North Anchorage, 17th October, 1928: 9 fath.



TEXT-FIG. 17*a*.—*Hircinia ramodigitata*, sp. n. Section at right angles to surface. × 70.



TEXT-FIG. 17*b*.—*Hircinia ramodigitata*, sp. n. Section tangential to surface, showing network of sand-grains and foreign spicules. × 70.

REMARKS.—The two varieties of this species recognized by Poléjaeff differ in two details only; in var. *friabilis* the fibres are filled with coarse *débris*, chiefly sand, and the dermis contains an even layer of similar material, and in var. *dura* the fibres contain

only extraneous siliceous spicules and the dermis is without foreign inclusions of any sort. Of the five specimens in the present collection, four agree in skeleton with the type of var. *dura* and one with var. *friabilis*. On the other hand, the one specimen agreeing with the var. *friabilis* in skeleton is identical with the var. *dura* in external form, and those agreeing with the var. *dura* in skeleton approximate closely to var. *friabilis* in external features. It seems probable, therefore, that the differences between the two varieties are of less significance than even Poléjaeff supposed. Possibly it is that the character of the material enclosed within the fibres of a given individual is determined by the nature of the substratum. The evidence in the present instance is not conclusive in this respect, however, since of the four containing only siliceous spicules, one was growing on a mixture of coral, shell, gravel and mud, another on a mixture of mud and shell *débris*, and the third on coarse sand. The nature of the bottom on which the fourth was growing is not known. In each of the first three there would appear to be considerable opportunity for the inclusion of sand-grains, as in the var. *friabilis*, but this has not taken place. Perhaps it is that local variations in the nature of the substratum, of which we are not aware, may be responsible for this anomaly. Each one of these individuals bears unmistakable evidence of having grown on large fragments of calcareous *débris*, chiefly coral, and shows no sign of contact with a muddy or sandy substratum. The one individual corresponding to the var. *friabilis* contains, on the other hand, considerable quantities of foreign inclusions corresponding to those forming the substratum, viz. chiefly the remains of foraminifera and small calcareous particles, with a sprinkling of quartz-grains and a few foreign spicules, so that here at least there is some correlation between the nature of the substratum and the type of material included by the sponge in its fibres.

Each of the present specimens contains some filaments, but the numbers present vary considerably, and in one specimen they are so rare as to be virtually absent. It is not difficult to conceive of their being entirely absent in some individuals, and we are compelled to regard the presence or absence of these filaments as a character of doubtful taxonomic value.

Hircinia schulzei, Dendy, is quite evidently identical with this species, while *Hippospongia frondosa*, Hentschel (1912, p. 435), has a great deal in common and may be identical with it.

Distribution.—Malay Area ; Indian Ocean.

Genus *Dysidea*, Johnston.

Duseideia, Johnston, 1842, p. 185 ; *Dysidea*, Johnston, 1842, p. 251 ; *Dysidia*, Agassiz, 1846, p. 131 ; *Spongelia*, Nardo, 1847, p. 3 ; *Dyseideia*, Lieberkühn, 1859, p. 363 ; *Duseidea*, Delage and Hérouard, 1899, p. 230.

Diagnosis.—Spongiidae with skeleton normally composed of a reticulation of primary and secondary fibres, usually entirely filled with foreign inclusions.

Remarks.—Johnston (1842, p. 185) established the genus *Duseideia*, but later in the same work (p. 251) altered the spelling to *Dysidea*. Since there is no rule as to which name shall be used, and as the second spelling is in accordance with the recommendations of the International Commission on Nomenclature, and with the standard practice of transliteration (or transcription), the name *Dysidea* is accepted here.

The genus *Dysidea* corresponds to *Spongelia*, as used by the majority of authors ;

but this name actually post-dates *Dysidea*. The genus *Spongelia* was established by Nardo in 1834 (p. 714) without diagnosis, and without having any species assigned to it. In 1847 (p. 3), Nardo refers to the species *Spongelia elegans*, which was subsequently re-described by Schmidt (1862, p. 28, pl. iii, fig. 5); and as it is probable that Schmidt had access to Nardo's types, *S. elegans* is here accepted as the genotype of *Spongelia*, in which case the name *Spongelia* must date from 1847.

Dysidea fragilis (Montagu). (Plate II, figs. 2–11; Text-figs. 18–33.)

Spongia fragilis, Montagu, 1818, p. 114, pl. xvi, figs. 1, 2; Gray, 1821, p. 360; Fleming, 1828, p. 526; Templeton, 1836, p. 471; *Duseideia fragilis*, Johnston, 1842, p. 187; pl. xiii, fig. 6; pl. xiv, fig. 4; *Spongelia fragilis*, Nardo, 1847, p. 3; *Spongia tupha*, Lieberkühn, 1859, p. 358; *Spongelia elegans*, Schmidt, 1862, p. 28, pl. iii, fig. 5; *S. avara*, *idem*, *l. c.*, p. 29, pl. iii, fig. 6; *S. incrustans*, *idem*, *l. c.*, p. 29, pl. iii, fig. 7; *S. pallescens*, *idem*, *l. c.*, p. 30, pl. iii, fig. 8; *S. pallescens*, Schmidt, 1864, p. 28; (?) *S. fistularis*, *idem*, *l. c.*, p. 28, pl. ii, figs. 28, 29; pl. iii, fig. 4; (?) *S. perforata*, *idem*, *l. c.*, p. 28; *Dysidea fragilis*, Bowerbank, 1864, p. 211, pl. xiv, figs. 270–272; *Spongelia elegans*, Kölliker, 1864, p. 66; *Dysidea fragilis*, Bowerbank, 1866, p. 381; *Spongelia fragilis*, Schmidt, 1870, p. 77; *Dysidea fragilis*, Bowerbank, 1874, p. 175, pl. lxix, figs. 1–3; *D. coriacea*, *idem*, *l. c.*, p. 341, pl. xci, fig. 20; D. *fragilis*, Carter, 1876, p. 232; *Spongelia pallescens* subsp. *fragilis* varr. *incrustans*, *tubulosa*, *ramosa*, subsp. *elastica* varr. *massa*, *lobosa*, Schulze, 1879, p. 138, pl. v, figs. 1–4; pl. vi, figs. 2–3, 5–7; *S. elegans*, *idem*, *l. c.*, p. 151, pl. v, fig. 5; *S. avara*, *idem*, *l. c.*, p. 127, pl. vi, figs. 1, 4; pl. viii, figs. 1–7, 13, 14; *S. spinifera*, *idem*, *l. c.*, p. 152, pl. v, fig. 6; pl. vi, figs. 8–10; *Dysidea fragilis*, Bowerbank, 1882, p. 188; *D. coriacea*, *idem*, *l. c.*, p. 189; *Spongelia pallescens*, Polejaeff, 1884, p. 42, pl. iii, fig. 1; *Dysidea fragilis*, Carter, 1885, p. 215; *D. cinerea*, Keller, 1889, p. 337, pl. xx, fig. 2; *D. nigra*, *idem*, *l. c.*, p. 338; *Spongelia spinifera*, Lendenfeld, 1889, p. 653; *S. elegans*, *idem*, *l. c.*, p. 655, pl. xxxix, fig. 2; *S. elastica*, *idem*, *l. c.*, p. 657; pl. xxxviii, fig. 8; pl. xliii, fig. 7; *S. elastica*, var. *massa*, *idem*, *l. c.*, p. 658, pl. xliii, fig. 7; *S. elastica* var. *lobosa*, *idem*, *l. c.*, p. 659; pl. xxxviii, fig. 8; *S. fragilis*, *idem*, *l. c.*, p. 660, pl. xxxvii, fig. 10; *S. fragilis* var. *irregularis*, *idem*, *l. c.*, p. 662, pl. xxxvii, fig. 10; *S. fragilis*, var. *incrustans*, *idem*, *l. c.*, p. 664; *S. fragilis*, var. *tubulosa*, *idem*, *l. c.*, p. 665; *S. avara*, *idem*, *l. c.*, p. 667, pl. xliii, figs. 3, 4, 6; *S. fragilis* var. *ramosa*, Dendy, 1905, p. 208; *S. elastica* var. *lobosa*, *idem*, *l. c.*, p. 208; *S. elastica* var. *crassa*, *idem*, *l. c.*, p. 209; *Dysidea cinerea*, Row, 1911, p. 365; *Spongelia spinifera* var. *australis*, Hentschel, 1912, p. 446; *S. fragilis* var. *clathrata*, *idem*, *l. c.*, p. 447; *S. fragilis* var. *ramosa*, Dendy, 1916, p. 139; *S. cinerea*, *idem*, *l. c.*, p. 140; *S. elegans* var., *idem*, *l. c.*, p. 140.

OCCURRENCE.—Stn. X, 22nd February, 1929: Satellite Reef, 14–17 fath., coral, shell, gravel and mud. Stn. XVII, 9th March, 1929: $\frac{1}{4}$ mile north of N. Direction Is., 19 fath., sand and thick *Halimeda*. Stn. XXIV, 13th March, 1929: $\frac{3}{4}$ mile N.E. of Pasco Reef, $16\frac{1}{2}$ fath., hard and shell bottom.

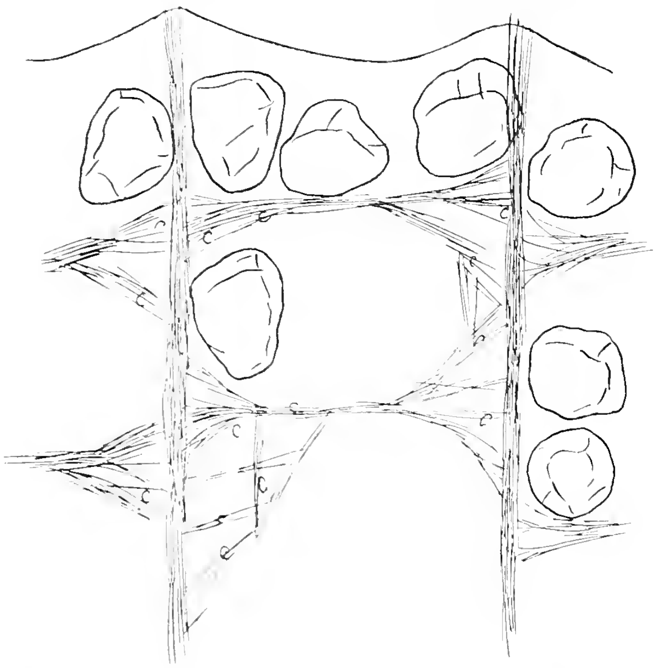
REMARKS.—The original description of *Spongia fragilis* clearly shows what Montagu (1818, p. 114) intended the name should represent, and this is supplemented by a more detailed description, together with figures, by Johnston (1842, p. 187, pl. xiii, fig. 6; pl. xiv, fig. 4). In the Bowerbank collection, preserved in the British Museum, is a specimen, B.M. 30.7.3.447, labelled "*Dysidea fragilis*, Type Specimen". The handwriting is unknown, but may be that of Johnston, and the specimen itself may have belonged to Montagu, and may actually be the one on which he based his original description. This is, however, pure surmise, for although there is reason to believe that some of the types of both Montagu and Johnston are in the Bowerbank collection, there is nothing on the labels to show this for a certainty. Under the circumstances, the matter can best be met by accepting this specimen as the neotype of *Spongia fragilis*, Montagu. The type being fixed, the next and more important step is to seek out the characters of the species and, more particularly, measure the variations to which these characters may

be subject. That the species is a variable one in all respects has been taken for granted; but, unfortunately, so much has been taken for granted that although the species figures prominently in the literature, and has been recorded from many parts of the world, it is impossible from the available records to express in precise terms its characters. As a result, we have, on the one hand, a large number of diverse forms identified by various authors as *Dysidea* (*Spongelia*) *fragilis*, or as varieties thereof, which may or may not belong to the species ; and, on the other hand, we have numerous other species described which may conceivably be synonymous with it.

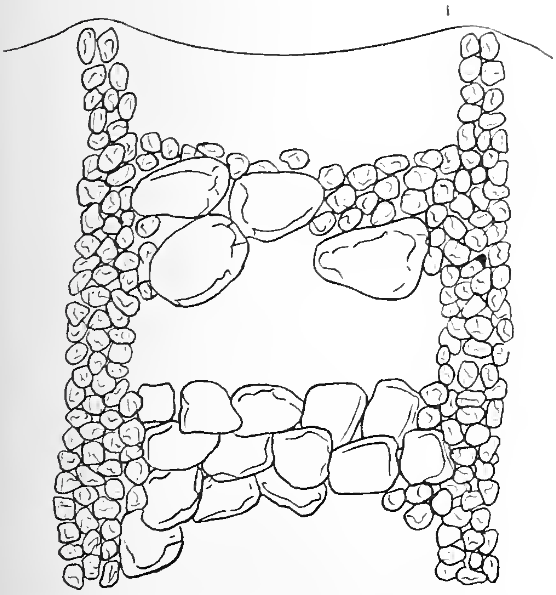
In addition to the specimen already discussed, there are in the Bowerbank collection nearly twenty other examples labelled "*Dysidea fragilis*, Montagu", collected from various parts of the British Isles. From their general resemblance to each other it may be safely assumed that these are all conspecific. In external form they vary to some extent, most of them being small and roundly massive or thinly encrusting with small oscules scattered irregularly over the surface. In some of these, incipient mammillate lobes may be seen, each bearing an oscule at the summit. By easy stages we pass from such forms to those consisting of a basal mass from which arise flabellate, mammillate or digitate upgrowths, which may fuse to give rise to irregular ridges or crests bearing oscules in linear series along the upper border of the crest. The oscules tend to be laterally placed on the digitate processes and apically in all other cases. The surface conuli are always present, but vary slightly in height and in the distance from each other. The distribution of the conuli is determined by the position of the main fibres of the skeleton, and varies as the distance between neighbouring main fibres varies. The type consists of a large massive specimen, 4 cm. high by 7 cm. long by 4 cm. across, with three large oscules on the upper surface, the largest 2 cm. in diameter, leading into deep cloacae.

The variations in external form are considerable, but are only of such magnitude as might be expected in such a species, but the variation in the structure of the skeleton is more striking. In the type (Text-fig. 19) it consists of fibres formed of foreign spicules, with large grains of sand scattered between. The reticulation so formed contains primary or ascending fibres and more slender and irregular secondary or transverse fibres. The spicules are mainly oxea with some styli, but include also numerous microscleres, sigmata, toxa and anisochelae. At first sight the specimen appears to be an example of *Gellius angulatus* (Bowerbank) containing sand-grains and foreign spicules, but other considertions suggest that it is a *Dysidea,* in which the spicules of *Gellius angulatus* form the major part of the foreign inclusions. Very little spongin is visible. A second specimen from the Bowerbank collection, B.M. 30.7.3.440, has for skeleton a reticulation of fibres filled with sand-grains, with no visible spongin. The secondary fibres are as regular as the primaries and thicker, the latter being due to the larger size of the enclosed sand-grains (Text-fig. 20). In B.M. 30.7.3.442, a third specimen, the fibres are again filled with sand-grains, but these are all small, and the secondary fibres, instead of being regular transverse fibres, form an irregular secondary network. Spongin is abundantly visible (Text-fig. 21). A fourth specimen, B.M. 30.7.3.441, has primary fibres filled with large sand-grains, the secondary fibres, which again form an irregular network, are for the most part without inclusions, but may contain fine sand-grains or a few fragments of spicules (Text-fig. 22). A fifth specimen, B.M. 30.7.3.446, has a similar skeleton to that of the fourth specimen, but spongin is less conspicuous in the primary fibres (Text-fig. 23). The remaining specimens have skeletons of characters similar to those of the foregoing

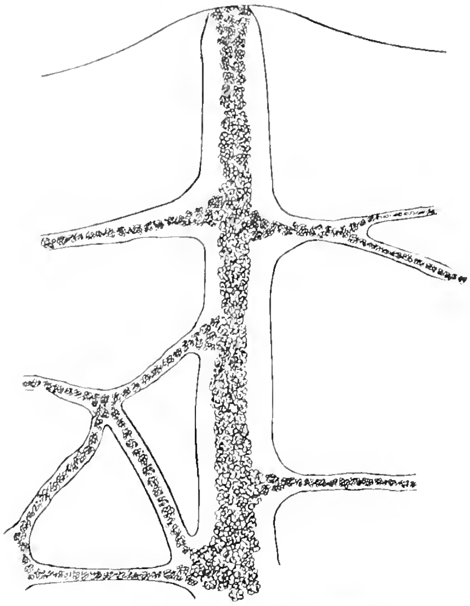
TEXT-FIG. 18.—*Dysidea fragilis* (Montagu), showing structure of fibre.



TEXT-FIG. 19.—Neotype of *Spongelia fragilis* (Montagu), B.M. 30.7.3.447. From a section at right angles to surface. × 50.

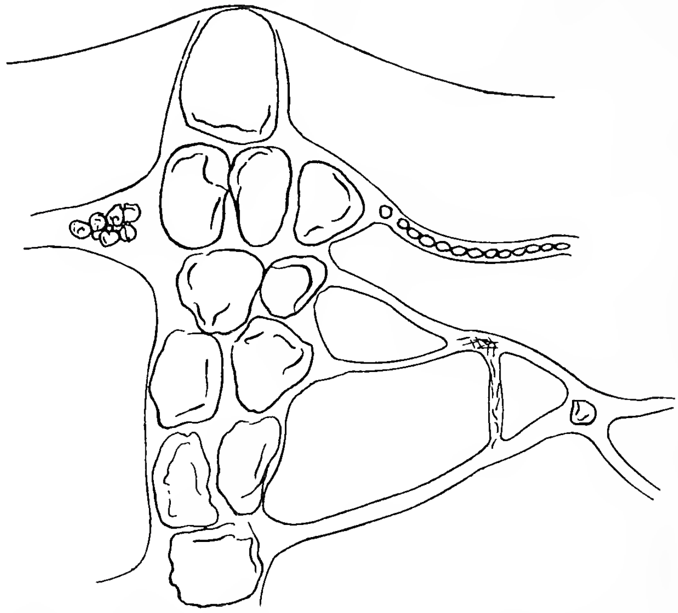


TEXT-FIG. 20.—*Dysidea fragilis* (Montagu), from the Bowerbank collection (B.M. 30.7.3.440). From a section at right angles to surface. × 50.

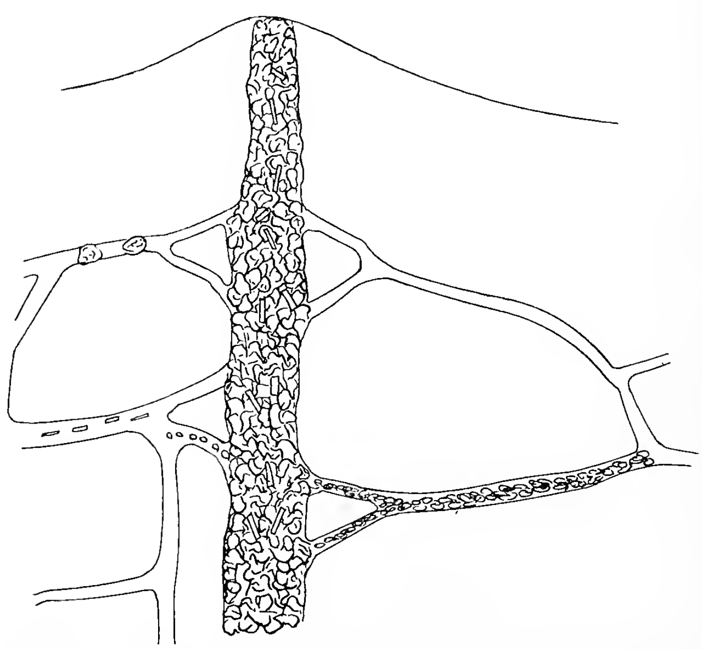


TEXT-FIG. 21.—*Dysidea fragilis* (Montagu), from the Bowerbank collection (B.M. 30.7.3.442). From a section at right angles to surface. × 50.

five specimens, or are of an intermediate nature. In each case the type of skeleton figured here is only the predominant form, and transitions from this to most of the others may be found in a single individual by careful searching.

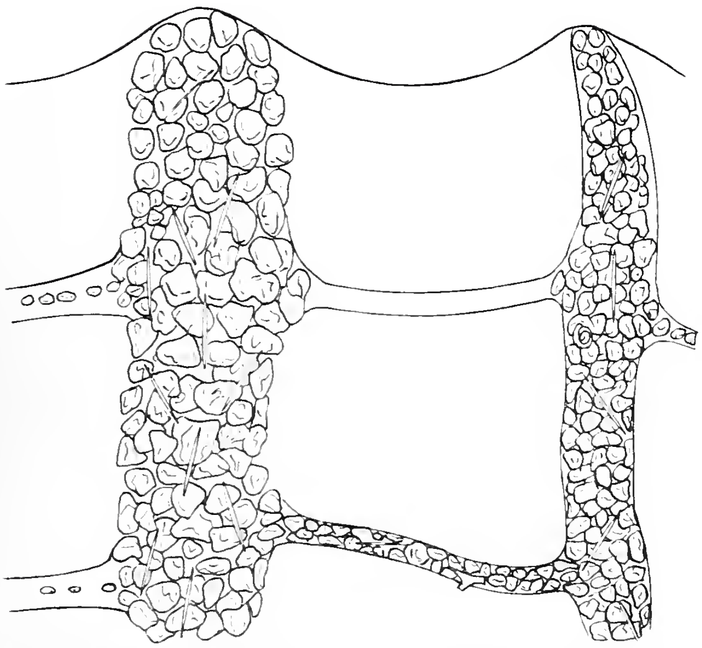


Text-fig. 22.—*Dysidea fragilis* (Montagu), from the Bowerbank collection (B.M. 30.7.3.441). From a section at right angles to surface. × 50.

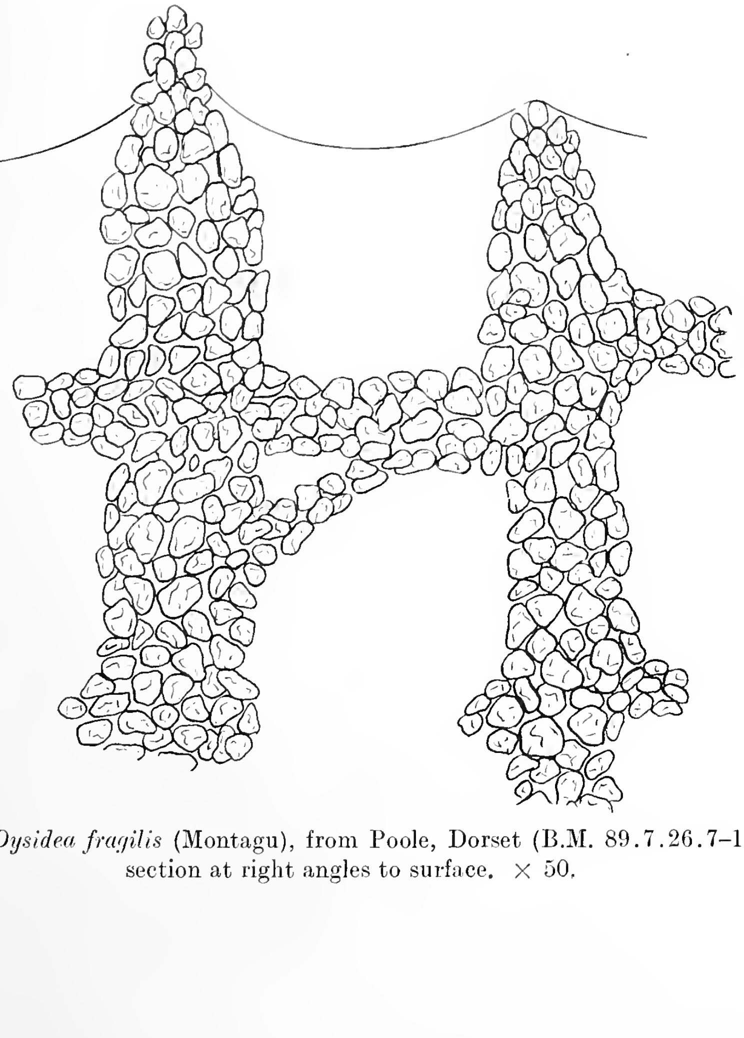


Text-fig. 23.—*Dysidea fragilis* (Montagu), from the Bowerbank collection (B.M. 30.7.3.446). From a section at right angles to surface. × 50.

In case there may be a possibility that certain types of skeleton may be correlated with a particular external form, further researches were made with other specimens showing a greater similarity externally than those in the Bowerbank collection. These show conclusively how variable is the skeleton in this species, not only in the structure



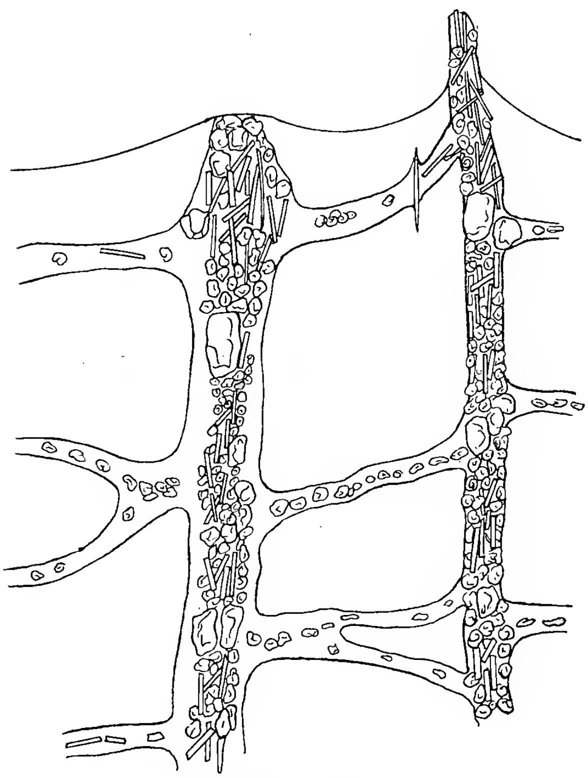
TEXT-FIG. 24.—*Dysidea fragilis* (Montagu), from the Dorset coast (B.M. 97.8.9.70–71). From a section at right angles to surface. × 50.



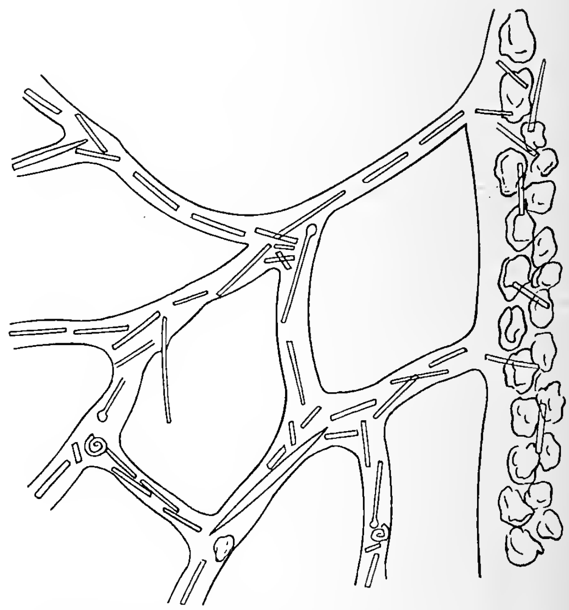
TEXT-FIG. 25.—*Dysidea fragilis* (Montagu), from Poole, Dorset (B.M. 89.7.26.7–12). From a section at right angles to surface. × 50.

of the main reticulation, but in the nature of the inclusions; and also that the type of skeleton bears no relation to the external form.

The material chosen consists of a group of specimens in the British Museum collection identified by various workers as *Spongelia fragilis* (Montagu). The first of these, B.M. 97.8.9.70–71, collected by Kirkpatrick on the Dorsetshire coast, is a small subspherical specimen about 1 cm. high (Plate II, fig. 9), with conulose surface and two small oscules on the upper surface. The skeleton consists of a coarse reticulation of primary fibres of spongin filled with moderately large sand-grains and occasional foreign spicules. The primary fibres are connected at intervals by more slender secondary fibres, which may be



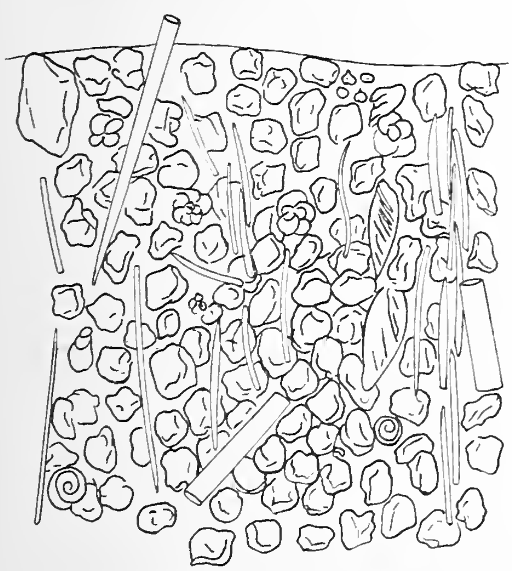
TEXT-FIG. 26.—*Dysidea fragilis* (Montagu), from the English Channel (B.M. 25.11.1.1034). From a section at right angles to surface. × 50.



TEXT-FIG. 27.—*Dysidea fragilis* (Montagu), from Littlehampton. From a section at right angles to surface. × 50.

completely filled with sand-grains, or may contain only a central core thereof, or may be entirely free from foreign inclusions (Text-fig. 24). The second specimen, B.M. 89.7.26.7–12, from Poole, is slightly larger than the first (Plate II, fig. 10), but resembles it closely in external appearance. In this, the skeleton is a coarse reticulation of fibres entirely filled with moderately large sand-grains. The secondary fibres are stout, and always completely filled with sand. Spongin is nowhere apparent in this sponge, although its presence may be assumed in view of the compact and regular structure of the fibres (Text-fig. 25). A third specimen, B.M. 25.11.1.1034, from the English Channel (?), closely resembling the first two specimens (Plate II, fig. 5), is slightly larger still, with oscules in linear series along the upper surface. In this the skeleton is again a reticulation of primary and secondary fibres, but both are much more slender, and the secondary

fibres are irregular and often branched. The inclusions are mainly foreign spicules and small grains of sand, with a few foraminifera and large sand-grains. In the primary fibres the inclusions do not occupy the whole of the fibre, and a considerable quantity of spongin is visible surrounding them. In the secondary fibres, too, much spongin is visible (Text-fig. 26). In a fourth specimen, from the Sussex coast, the external form is very like that of the three already discussed, and the skeleton agrees on the whole with that of B.M. 97.8.9.70–71. An interesting modification occurs, however, in that the secondary fibres (Text-fig. 27), instead of remaining simple or only slightly branched, form an irregular network reminiscent of *Spongelia avara* (see Schulze, 1879, pl. vi, fig. 5). The general resemblance between these four specimens is such that no one would hesitate to regard them as representatives of a single species, yet the differences in the skeleton are considerable. The only conclusion to be drawn is, therefore, that the skeleton in this



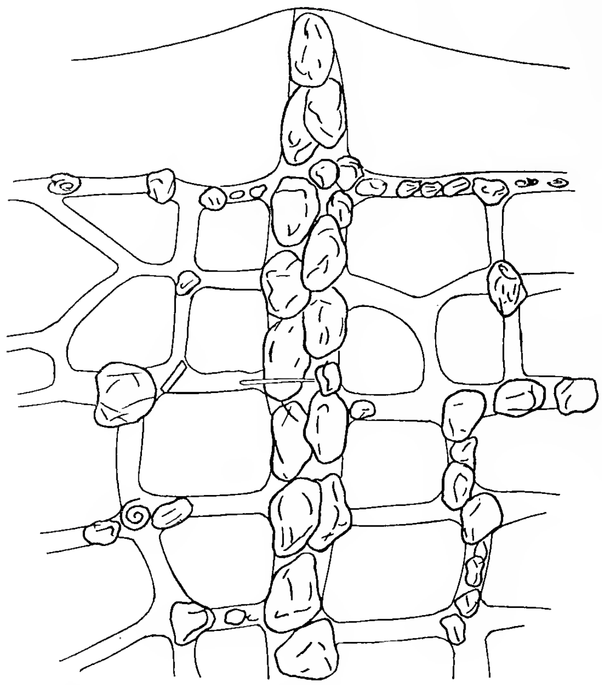
Text-fig. 28.—*Dysidea fragilis* (Montagu), from Norway (B.M. 10.1.1.598). From a section at right angles to surface. × 50.

Text-fig. 29.—*Dysidea fragilis* (Montagu), from Hastings (B.M. 81.5.5.31–3). From a section at right angles to surface. × 50.

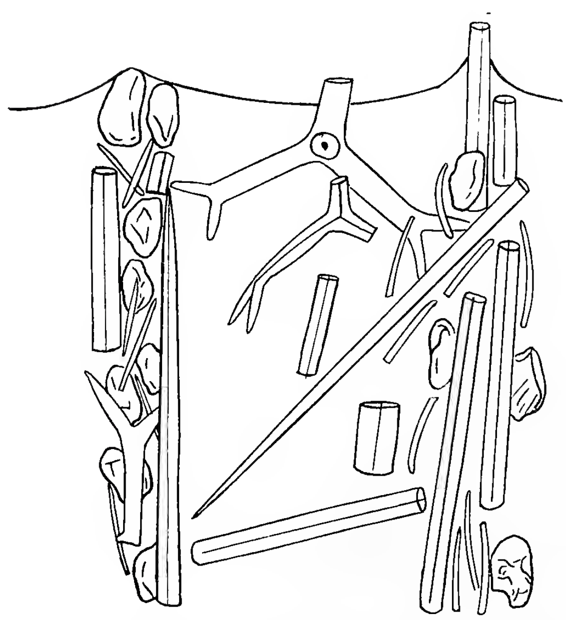
species consists typically of a reticulation of spongin fibres, with stout primary and slender secondary fibres, which may be filled, or even replaced, to a varying degree by foreign inclusions; and that these inclusions may be of differing nature, such as sand-grains, sponge-spicules or foraminifera. Further, that the secondary fibres may be simple transverse connectives, or may branch and anastomose to form an irregular reticulation.

Comparing this group of four specimens with others already described, we see that the variations found in them only foreshadow what takes place in others. The specimen of *S. fragilis* recorded by me (1930, p. 496) from Norway, B.M. 10.1.1.598, has the same external form as B.M. 89.7.26.7–12, but has a somewhat coarser texture (Plate II, fig. 11), and the skeleton consists of a dense mass of sand-grains, sponge-spicules and foraminifera completely filling the choanosome. There is no visible sign of spongin, and the only hint of the suppressed reticulation typical of this species is found in the arrangement of some of the foreign spicules in ascending bands vertical to the surface (Text-fig. 28). A second specimen from Hastings, B.M. 81.5.5.31–33, collected and

identified by Ridley, has a similar skeleton composed entirely of large sand-grains (Text-fig. 29). The specimen itself is depressed and spreading (Plate II, fig. 6). The surface conules are coarse and obtusely ended and the texture of the sponge harsh, as would



TEXT-FIG. 30.—*Spongelia pallescens*, Schmidt (B.M. 67.7.26.9). From a section at right angles to surface. × 50.

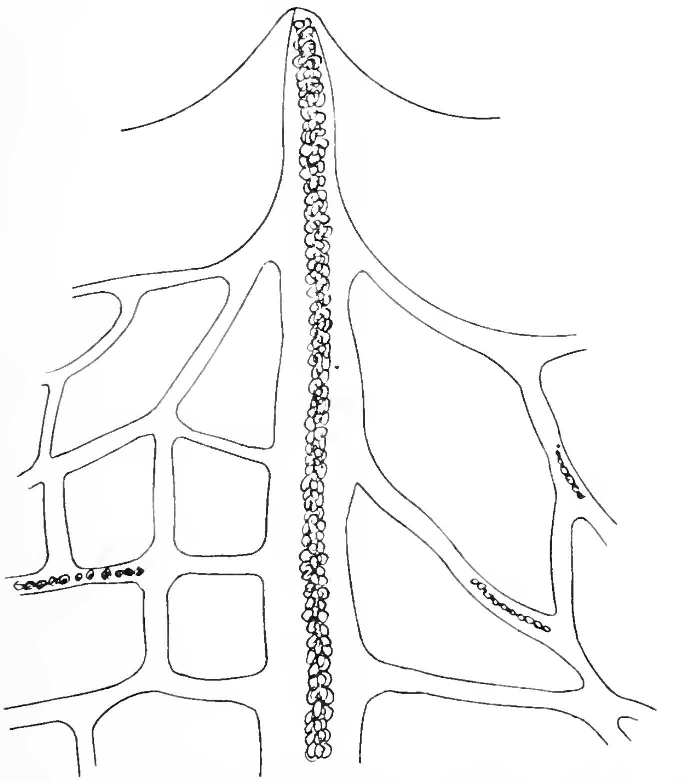


TEXT-FIG. 31.—*Spongelia pallescens*, Schmidt, from S.W. of Ireland (B.M. 82.7.28.12–15). From a section at right angles to surface. × 50.

naturally result from the tissues of the sponge being filled with coarse sand. The depressed form of the sponge is not unusual, since in the same jars as B.M. 97.8.9.70–71 and 89.7.26.7–12, and obviously conspecific with them, occur thinly encrusting and depressed

forms. In some cases these depressed forms bear low mammillate processes, each with an oscule at the summit. The significance of this will be seen later.

A specimen, B.M. 67.7.26.9. from the Adriatic, purchased of O. Schmidt and labelled, in his handwriting, *Spongelia pallescens*, has a similar external form to those specimens from the English coast described above (Plate II, fig. 4). This appears to be the type-specimen figured by Schmidt (1862, pl. iii, fig. 8), and is accepted here as the holotype of *S. pallescens*. In this the skeleton consists of stout primary fibres filled with sand-grains, and an irregular reticulation of secondary fibres sprinkled with sand-grains (Text-fig. 30).



TEXT-FIG. 32.—*Spongelia pallescens*, var. *elastica*, Schulze (B.M. 83.12.4.26). From a section at right angles to surface. × 50.

Carter's specimen (1876, p. 232) of *S. pallescens* from S.W. Ireland, B.M. 82.7.28.12–15, is a small, massive specimen with the usual surface conulation, with oscules on the upper surface and a coarse texture. The skeleton is composed of the spicules of *Stryphnus ponderosus* (Bowerbank), and a few sand-grains arranged in an incipient reticulation, but with no visible spongin (Text-fig. 31).

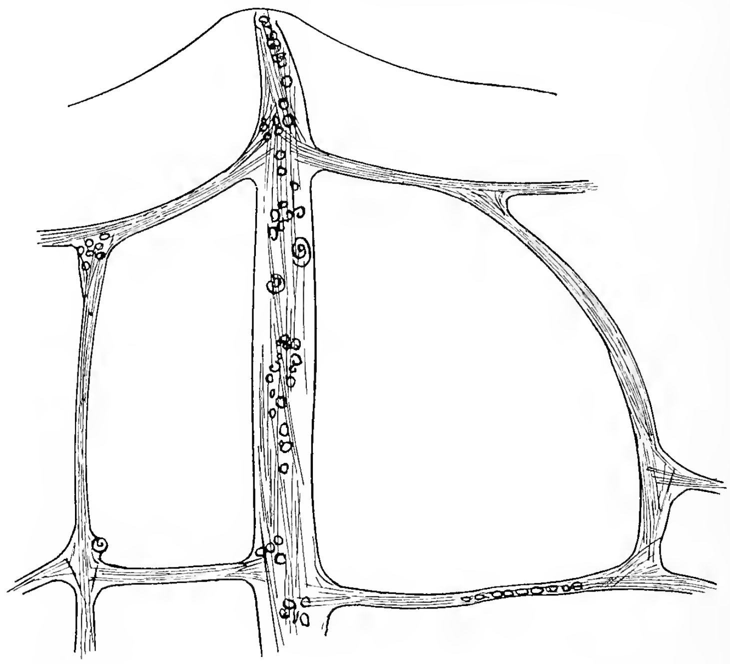
All the specimens enumerated above may be regarded as conspecific, and, now that some measure of the variation of the skeleton has been found, it is possible to consider which of the forms hitherto described belong also to *Dysidea fragilis* (Montagu).

Dysidea coriacea, Bowerbank, represented in the Bowerbank collection by two specimens, has the encrusting form and external appearance commonly found in *D. fragilis*, and is apparently conspecific with that species. In the first of the two specimens the skeleton is intermediate between those of B.M. 10.1.1.598 and B.M. 97.8.9.70–71. The skeleton of the second consists of primary fibres with very little foreign matter

included, and an irregular secondary network of fibres free from inclusions, very much as in *Spongelia pallescens*, var. *elastica* (Text-fig. 32).

According to Schulze (1879, p. 125), *Spongia tupha*, Pallas (1766, p. 398), is a *Spongelia* (= *Dysidea*), and Schmidt (1862, p. 58) has suggested the possibility of its identity with his *Spongelia elegans*, Nardo. Pallas's description of *Spongia tupha* is not sufficient for the recognition of the species, and such speculations as those of Schulze and Schmidt are meaningless. On the other hand, the *Spongia tupha* of Martens (1824, p. 534) and Lieberkühn (1859, p. 358) is almost certainly the same thing as *Dysidea fragilis* (Montagu).

Spongelia elegans, Nardo, the type of the genus *Spongelia*, is unrecognizable from the original description, but Schmidt (1862, p. 28, pl. iii, fig. 5) has assigned certain specimens to it which appear to be digitate forms of *Dysidea fragilis*. The specimens of both Nardo and Schmidt are not available for examination, but as the latter probably saw



TEXT-FIG. 33.—*Spongelia pallescens*, var. *fragilis*, Schulze (B.M. 83.12.14.18). From a section at right angles to surface. × 50.

Nardo's types, and as his figure can be recognized with some degree of accuracy, *Spongelia elegans*, Nardo, is here accepted as a synonym of *Dysidea fragilis*. In the same work Schmidt describes three new species of *Spongelia*, *S. avara*, *S. incrustans* and *S. pallescens*. The last of these has been shown above to be a synonym of *Dysidea fragilis*, and *Spongelia incrustans* from Schmidt's figure is almost certainly the same. *S. avara* seems to differ from *Dysidea fragilis* in that the surface conules are from 2 mm. to 5 mm. apart, but whether this can be regarded as sufficient reason for specific distinction is doubtful, though it is true that the specimen identified by Schulze (1879) as *Spongelia avara*, Schmidt, may conceivably be specifically distinct from Montagu's species. The difference between the holotype of *S. avara* and Schulze's specimens is due entirely to a greater distance between the conules in the latter, though this is hardly a matter for specific distinction.

It would be impracticable here to consider in detail every specimen, but the list of synonyms given above has been compiled by comparison of type and authentic specimens, or with written descriptions where no specimens were available, with a large series of

Dysidea fragilis from European waters, and there is little reason to doubt that all the forms therein mentioned are conspecific.

DISTRIBUTION.—Almost cosmopolitan.

Dysidea reticulata (Thiele).

Dysideopsis reticulata, Thiele, 1899, p. 28, pl. iii. fig. 7 : *Spongelia elegans*, Shaw, 1927, p. 438.

OCCURRENCE.—Stn. XXV, 17th March, 1929 : in Papuan Pass, 20–25 fath., foraminifera and coral fragments.

REMARKS.—The specimen is fragmentary, and consists of irregular cylindrical branches with finely conulose surface. The surface conuli are only barely perceptible, but their positions are marked by small, light-coloured patches, the ends of the sand-filled primary fibres showing through the dermis. The skeleton is an irregular network of sand-filled fibres, in which primary fibres can with difficulty be recognized. The sand-grains are mainly of small size and the primary fibres measure ·09 mm. in diameter, the secondary fibres being about ·048 mm. in diameter.

The Barrier Reef specimen does not agree in all respects with the holotype of the species, particularly in the matter of the appearance of the surface. In the holotype the surface conuli are more pronounced, and the sponge itself consists of a basal mass from which short digitate processes arise. The specimens described by Shaw (*loc. cit.*) as *Spongelia elegans*, Nardo, are, however, intermediate to some degree betwen the holotype and the present specimen. They consist mainly of bunches of erect digitate processes, and in some the basal mass is conspicuous, but in others the processes arise directly from the substratum. They show also that the development of the surface conuli is subject to some variation, and comparing them with the holotype and the Barrier Reef specimen, it seems probable that all are representatives of a single species.

DISTRIBUTION.—Celebes ; Tasmania.

Dysidea herbacea (Keller).

Spongelia herbacea, Keller, 1889, p. 336, pl. xx, fig. 1 ; *Dysideopsis palmata*, Topsent, 1897, p. 482, pl. xx, fig. 25 ; *Spongelia delicatula*, Row, 1911, p. 364 ; *S. digitata*, Sollas, 1902, p. 220, pl. xiv, fig. 4 ; pl. xv, fig. 2 ; *Dysideopsis topsenti*, Hentschel, 1912, p. 439 ; *Spongelia elegans*, var., Dendy, 1916, p. 140 ; *nec Spongelia elegans*, Nardo et Auctt.

OCCURRENCE.—Between Anchorage Reefs and Mangrove Park, Mangrove Park, Low Isles and Batt Reef. Stn. XXIII, 12th March, 1929 : in lee of Turtle Is., 8 fath., mud and shell.

DISTRIBUTION.—Red Sea ; Indian Ocean ; Malay Area ; Australia (south coast).

Family APLYSINIDAE.

Genus *Luffariella*, Thiele.

Luffariella variabilis (Poléjaeff).

Luffaria variabilis, Poléjaeff, 1884, p. 69, pl. ix, figs. 1–6 ; *Luffariella variabilis*, Thiele, 1899, p. 25.

OCCURRENCE.—Stn. XXI, 11th March, 1929 : $\frac{1}{2}$ mile N.W. of Howick Is., 10 fath., mud, shells and foraminifera. Stn. XXIV, 13th March, 1929 : $\frac{3}{4}$ mile N.E. of Pasco Reef, $16\frac{1}{2}$ fath., hard, shelly.

Remarks.—The two specimens have the massive form of the second of Poléjaeff's specimens, but the surface characters of his ramose form. In other features they agree closely with both.

Distribution.—New Hebrides and Tahiti.

Genus *Aplysina*, Nardo.

Aplysina mollis, Row, var. *aruensis*, Hentschel.

A. mollis, var. *aruensis*, Hentschel, 1912, p. 436.

Occurrence.—Stn. X, 22nd February, 1929: Satellite Reef, 14–17 fath., coral, shell, gravel and mud.

Remarks.—The two sponges consist of irregular basal masses from which digitate processes, several centimetres high and up to ·5 cm. diameter, arise. They appear to agree with Hentschel's (*loc. cit.*) description of var. *aruensis*, but to differ markedly from Row's specimen. If the identification of the present specimens proves correct, it will probably be necessary to regard the var. *aruensis* as a distinct species.

Distribution.—Aru Island.

Genus *Druinella*, Lendenfeld.

Druinella purpurea (Carter).

Aplysina purpurea, Carter, 1880, p. 36; Dendy, 1889, p. 971; *A. purpurea*, Carter, 1881, p. 366; *nec* Dendy, 1905, p. 224, and Row, 1911, p. 377; *nec Psammopemma purpureum* (Carter), Kirkpatrick, 1900, p. 358.

Occurrence.—Low Isles, the Thalamita Flat, Mangrove Park and North-east Moat.

Remarks.—The original description gives little information concerning the characters of the species, except that it is " cactiform on the surface ", irregular, and black-purple in colour. Later, Carter (1881) described other specimens from Ceylon and Australia, under the same name, and one of these he figured. According to these figures the sponge from Ceylon is cactiform and black-purple in colour, with a skeleton in which the main fibres are fasciculated (*cf.* Carter, 1881, pl. ix, fig. 1*h*). On the other hand, Dendy's specimen from the Gulf of Manaar has a different type of skeleton and belongs to the genus *Druinella*, Lendenfeld. In either case, it is more probable that Dendy's sponge, from the type-locality, should be conspecific with the holotype than Carter's second specimen, from Ceylon. Therefore, if it should prove that the holotype is definitely lost, as seems probable, I would suggest that Dendy's specimen from the Gulf of Manaar be taken as neotype; and provisionally, I accept this sponge as the type of the species.

The four specimens of the present collection all agree with the type, as here understood, so that the species certainly extends from India to the Great Barrier Reef; and it is of interest to record another typical example from Cape Boileau, N.W. Australia (B.M. 30.12.1.13).

Too much stress laid on the purple colour, and too little on the more essential details of anatomy, has led to errors by various authors. For example, Carter's specimens of

Aplysina purpurea from Ceylon and Australia belong to the genus *Psammaplysilla*, Keller, and may even be conspecific with the genotype, *P. arabica*. Lendenfeld (1889, p. 636) has suggested the identity of *Holopsamma fuliginosum*, Carter, and *Pseudoceratina durissima*, Carter, with *Aplysina purpurea*. Carter (1881, *nec* 1880), but all three are generically distinct, and none is congeneric with *A. purpurea*, Carter, *sensu stricto*.

Psammopemma purpureum (Carter), Kirkpatrick (1900, p. 358), is probably synonymous with *Halisarca rubitingens*, Carter.

Distribution.—India ; N.W. Australia ; Great Barrier Reef.

Druinella ramosa, Thiele.

D. ramosa, Thiele, 1899, p. 24, pl. iii, fig. 3; pl. iv, fig. 5.

Occurrence.—Outer Barrier, Ribbon Bay, middle zones, 4th June, 1929 ; Outer Barrier, Yonge Bay, Reef Crest, 5th June, 1929.

Distribution.—Celebes.

Family Aplysillidae.

Genus *Aplysilla*, Schulze.

Aplysilla rosea (Barrois).

(For synonymy see Burton, 1930, p. 510.)

Occurrence.—Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., rock and shell gravel, mud on edges of pit.

Distribution.—Mediterranean ; Atlantic coasts of Europe ; Australia (east coast).

Genus *Dendrilla*, Lendenfeld.

Dendrilla membranosa (Pallas).

Spongia membranosa, Pallas, 1766, p. 398 ; *S. membranacea*, Esper, 1794, p. 256, pl. xxxiv ; *Spongelia cactus*, Selenka, 1867, p. 565 ; *Aplysilla cactus*, Schulze, 1878, p. 417 ; *Dendrilla rosea*, Lendenfeld, 1883, p. 271, pl. x, figs. 3, 4 ; pl. xii, figs. 16, 19–23; pl. xiii, figs. 24–27, 29–31 ; *Aplysina membranosa*, Ridley, 1884, p. 391 ; *A. pallasi*, *idem*, *l. c.*, p. 600 ; *Luffaria rosea*, Carter, 1885, p. 201 ; *Aplysina caespitosa*, *idem*, *l. c.*, p. 282 ; *A. massa*, *idem*, *l. c.*, p. 284 ; *A. noevus*, *idem*, *l. c.*, p. 285 ; ? *A. cruor*, *idem*, *l. c.*, p. 286 ; *Dendrilla membranosa*, Lendenfeld, 1889, p. 715 ; *D. rosea* var. *typica*, *idem*, *l. c.*, p. 718, pl. xliv, figs. 4, 7, 11 ; pl. xlv, figs. 3, 4, 7, 9, 11 ; *D. rosea* var. *digitata*, *idem*, *l. c.*, p. 718, pl. xliv, fig. 8; pl. xlv, fig. 8 ; *D. ianthelliformis*, *idem*, *l. c.*, p. 719 ; *D. cavernosa*, *idem*, *l. c.*, p. 719, pl. xliv, figs. 3, 5, 12 ; pl. xlv, figs. 2, 5 ; *Spongelia chilensis*, Thiele, 1905, p. 485, fig. 20 ; *Dendrilla antarctica*, Topsent, 1908, p. 11, pl. iii, fig. 2 ; pl. iv ; *Aplysina praetensa*, Row, 1911, p. 374, pl. xxxvi, fig. 11 ; *Cacospongia cavernosa*, *idem*, *l. c.*, p. 377 ; *Dendrilla rosea*, var. *typica*, Hentschel, 1912, p. 930 ; *D. mertoni*, *idem*, *l. c.*, p. 433 ; *Dendrilla antarctica*, Hentschel, 1914, p. 137 ; *Megalopastas retiaria*, Dendy, 1916, p. 137, pl. iv, fig. 27 ; *Dendrilla antarctica*, Topsent, 1917, p. 31 ; *D. cavernosa*, Shaw, 1927, p. 437 ; *D. membranosa*, Burton, 1929, p. 448.

Occurrence.—Stn. XII, 24th February, 1929 : Penguin Channel, 10–15½ fath., rock and shell gravel. Stn. IX, 22nd February, 1929 : Penguin Channel, 12–14 fath.

Remarks.—The above list of synonyms is probably far from complete. It includes only the names of species and varieties whose representative specimens, in most cases type-specimens, have been examined, or such species as are obviously shown by their

original descriptions to be synonyms of *D. membranosa* (Pallas). Doubtless a number of other described species will prove eventually to be synonymous with this species.

The various specimens here regarded as belonging to this species differ in slight details of form, colour, thickness of fibre and in the size of the meshes forming the skeleton, all of which are commonplace variations. The external form ranges from encrusting to irregularly massive, flabellate or digitate.

Distribution.—Red Sea; Indian Ocean; Malay Area; Australia (north coast); Antarctic; S. America.

Genus *Basta*, Oken.

Basta, Oken, 1815, p. 77; *Ianthella*, Gray, 1869, p. 49.

Remarks.—The name *Ianthella* has been universally accepted for *Spongia flabelliformis*, Pallas, and its allies, but, unfortunate though it be, it is not possible to ignore the earlier name given by Oken. This author included two species in the genus *Basta*, *B. ventilabrum* and *B. flabelliformis*, and added "Hierher *Spongia basta*." Whatever else he may have meant, and his references to the genus and its species are not very lucid, it is clear that Oken regarded *Spongia basta*, Pallas, as the representative of his genus *Basta*, with *B. flabelliformis*, Pallas, as a second species. It is not clear what the *B. ventilabrum* mentioned by Oken was intended to represent.

Basta flabelliformis (Pallas).

Spongia flabelliformis, Pallas, 1766, p. 380; *Ianthella flabelliformis*, Gray, 1869, p. 49; *Verongia flabelliformis*, Ehlers, 1870, p. 11; *Ianthella flabelliformis*, Lendenfeld, 1889, p. 696, pl. xlvii, figs. 1–4, 6; pl. xlviii, figs. 1–4; pl. xlix, figs. 1–3; Whitelegge, 1902, p. 62 (sep. copy); Hentschel, 1912, p. 434; Wilson, 1925, p. 474. (For further synonymy see Lendenfeld, 1889.)

Occurrence.—Stn. XII, 24th February, 1929: Penguin Channel, 10–15½ fath., rock and shell gravel.

Distribution.—Indian Ocean; Malay Area; Philippines; Australia (north, east and west coasts).

SPONGES OF THE SAVILE KENT COLLECTION FROM THE GREAT BARRIER REEF; WITH A NOTE ON *CALLYSPONGIA RAMOSA* (GRAY).

I. The Savile Kent Collection.

The following species are represented in the British Museum collection by specimens collected by Savile Kent; but as these specimens bear only the label "Great Barrier Reef: Savile Kent Coll.", and no more exact information is available as to the locality, it has been thought better to include them in an appendix.

Unlike the species of which material was obtained by the Great Barrier Reef Expedition, the species represented by the Savile Kent collection are exclusively Australian.

Haliclona brassicata (Carter).

Phakellia brassicata, Carter, 1885, p. 363; *Reniera vasiformis*, *idem*, 1886. p. 445; *R. brassicata*, Dendy, 1895, p. 236.

Occurrence.—Great Barrier Reef; Savile Kent coll.
Distribution.—Australia (east and south coasts).

Callyspongia ramosa (Gray).

Spongia ramosa, Gray, 1843, p. 295; *Pachychalina ramosa*, Dendy, 1898, p. 318, pl. xxxiii. (See also p. 603.)

Occurrence.—Great Barrier Reef; Savile Kent coll.
Distribution.—New Zealand; Australia (east and south coasts).

Genus *Euplacella*, Lendenfeld.

Euplacella, Lendenfeld, 1887, p. 798; *Placochalina*, *idem*, *l. c.*, p. 790.

Genolectotype.—*E. australis*. Lendenfeld. 1887, p. 789.

Diagnosis.—Chalininae with main skeleton a coarse reticulation of stout, horny fibres cored by oxea; special dermal skeleton of more slender fibres forming a reticulation of polygonal mesh, subdivided by secondary fibres, echinated at nodes by brushes of spicules set at right angles to surface.

Remarks.—The original diagnosis of *Euplacella* reads: "Dünnplatige Plocochalininae mit glatter Oberfläche und zahlreichen regelmässig vertheilten Osculis, welche ausschliesslich auf einer Seite vorkommen. Skeletnetz eng, hexactinellid, mit dicker Fasern. Mit kleinen, schlanken wenig zahlreichen Nadeln." In this the statements concerning the skeleton and the spicules contain nothing diagnostic, as they are applicable equally to all Chalininac of the "Pachychalina" type. The genus is founded, thercfore, entirely on the external form. The genus *Placochalina* is similarly founded on external form, viz.: "Grosse, derbe, gesticlte, plattige, Placochalininae mit hochwelliger Oberfläche, dicken Skeletfasern und undeutlichen oder mit einem Netz übersponnenen Osculis". On comparing Lendenfeld's descriptions and figures of thc various species assigned to these genera, it is apparent that the species are not only congencric, but thc majority are conspecific. On the other hand, the one essential feature characterizing them all, and distinguishing them sharply from other genera of the "Pachychalina" group, namely, the peculiar structure of the dermal skeleton, is entirely overlooked.

External form cannot be uscd alone as a means of generic distinction in a group in which this feature is so variable. The characteristic structure of the dermal skcleton must therefore be thc chief means of diagnosis. And on this basis, a number of other species must be included in the genus *Euplacella* as here understood. These include *Siphonochalina annulata*, Ridley and Dendy, *Pachychalina elongata*, Ridley and Dendy, *Chalinissa communis*, Lendenfeld (see p. 598), *Phylosiphonia stalagmitis*, Lendenfeld, and *P. elegans*, Lendenfeld.

Euplacella australis, Lendenfeld.

E. australis, Lendenfeld, 1887, p. 789 ; *E. frondosa*, *idem*, *l. c.*, p. 789, pl. xxi, fig. 36 ; *Pachychalina australis*, Whitelegge, 1906, p. 457.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—The single specimen is typical in all respects.

Distribution.—Australia (north, east, west and south coasts).

Euplacella annulata (Ridley and Dendy).

Siphonochalina annulata, Ridley and Dendy, 1886, p. 331 ; *eidem*, 1887, p. 31, pl. vii, fig. 2 ; *Phylosiphonia annulata*, Lendenfeld, 1887, p. 789, pl. xxiii, fig. 45 ; *Siphonochalina annulata*, Whitelegge, 1906, p. 459.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—Two specimens were obtained : the first consists of a group of tubes, 9 cm. high, rising from a common base ; and the second is stipitate, with a series of 7 tubes arranged fan-wise at the top of a stout stalk, the total height of the specimen being 17 cm. In both the skeleton is typical.

Distribution.—Australia (south and east coasts).

Euplacella communis (Lendenfeld).

Chalinissa communis, var. *flabellum*, Lendenfeld, 1887, p. 772, pl. xx, fig. 32; pl. xxvii, figs. 5, 11, 13, 15 ; *C. communis*, var. *digitata*, *idem*, *l. c.*, p. 772, pl. xx, fig. 30 ; *C. tenuifibris*, *idem*, *l. c.*, p. 773, pl. xx, fig. 29 ; *C. serpens*, *idem*, *l. c.*, p. 773, pl. xx, fig. 33 ; *C. elegans*, *idem*, *l. c.*, p. 773, pl. xx, fig. 27 ; *C. rigida*, *idem*, *l. c.*, p. 773 ; *C. elongata*, *idem*, *l. c.*, p. 774, pl. xx, fig. 34 ; *C. ramosa*, *idem*, *l. c.*, p. 774, pl. xx, fig. 31.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—The representatives of the species included in the above list of synonyms are so obviously conspecific, when examined side by side, that it is unnecessary to say more about them.

Distribution.—Australia (east coast).

Euplacella mollissima, Lendenfeld.

Cavochalina bilamellata, Carter, 1885, p. 287 ; *Euplacella mollissima*, Lendenfeld, 1887, p. 790, pl. xxi, fig. 37 ; *Placochalina pedunculata*, var. *dura*, *idem*, *l. c.*, p. 791, pl. xxi, fig. 38 ; *P. pedunculata*, var. *poculum*, *idem*, *l. c.*, p. 792, pl. xxi, fig. 39 ; *P. pedunculata*, var. *mollis*, *idem*, *l. c.*, p. 792, pl. xxi, fig. 35. *Nec Spongia bilamellata*, Lamarck; *nec Cribrochalina poculum*, Schmidt.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—It is doubtful whether this species is really distinct from *E. australis*, Lendenfeld.

There is a large series of specimens in the British Museum collection which shows clearly that the various species and varieties included in the synonymy list above are identical.

Distribution.—Australia (north, east and south coasts).

Tedaniopsamma, gen. n.

Genotype.—*Hircinia flabellopalmata*, Carter.

Diagnosis.—Myxillinae with main skeleton composed of a reticulation of horny fibres, filled with sand, with styli and raphides scattered in its interstices.

Remarks.—Lendenfeld (1889, p. 605) assigned *Hircinia flabellopalmata*, Carter, to the genus *Sigmatella*, remarking that the proper spicules were strongyla only. The spicules in the holotype of this species are styli and slender raphides, and the same is true of the three specimens from the Barrier Reef, which agree exactly with the holotype in external form also. The sponge figured by Lendenfeld (*loc. cit.*) appears to be the holotype, so that that author's statement regarding the spiculation may be taken to be the result of inaccurate observation.

Tedaniopsamma flabellopalmata (Carter).

Hircinia flabellopalmata, Carter, 1885, p. 313 ; *Sigmatella flabellipalmata*, Lendenfeld, 1889, p. 616, pl. xxxix, fig. 1 ; pl. xli, fig. 5.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—Three specimens, the largest 60 cm. high by 30 cm. across.

Distribution.—Australia (south coast).

Clathria transiens, Hallmann.

C. transiens, Hallmann, 1912, p. 226, pl. xxxiii, figs. 1–3 ; pl. xxxiv, fig. 2 ; text-figs. 47, 48*a*.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Distribution.—Australia (south coast).

Wilsonella australiensis, Carter.

W. australiensis, Carter, 1885, p. 366 ; *Clathria australiensis*, Dendy, 1896, p. 33.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Distribution.—Australia (south coast).

Ophlitaspongia tenuis (Carter).

(For synonymy see Hallmann, 1912, p. 261.)

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Remarks.—The single specimen is thinly lamellar, very proliferous, anastomosing and low-growing. Thus it resembles in outward form both *Clathria angulifera*, Dendy, and *Wilsonella connectens*, Hallmann (1912, pl. xxxii, fig. 2), but the spiculation is typical.

Distribution.—Australia (south coast).

Ophlitaspongia axinelloides, Dendy.

O. axinelloides, Dendy, 1896, p. 39.

Occurrence.—Great Barrier Reef ; Savile Kent coll.

Distribution.—Australia (south coast).

Echinochalina glabra (Ridley and Dendy).

Echinoclathria glabra, Ridley and Dendy, 1886, p. 476 ; *idem*, 1887, p. 163, pl. xxix, fig. 11 ; pl. xxi, fig. 2 ; Dendy, 1896, p. 40 ; *Thalassodendron viminalis*, Whitelegge, 1901, p. 87 ; *Echinoclathria intermedia*, *idem*, 1902, p. 214 ; *Echinochalina reticulata*, *idem*, 1907, p. 506, pl. xlv, fig. 25 ; *E. glabra*, *idem*, *l. c.*, p. 507 ; *E. rcticulata*, Hallmann, 1912, p. 289, pl. xxx, fig. 2, text-fig. 66 ; *E. reticulata*, var., *idem*, *l. c.*, p. 290, pl. xxxi, fig. 1 ; *E. glabra*, *idem*, *l. c.*, p. 290, text-fig. 67 ; *E. anomala*, *idem*, *l. c.*, p. 294, text-fig. 69.

OCCURRENCE.—Great Barrier Reef ; Savile Kent coll.

REMARKS.—The various specimens recorded under the names included in the above list of synonyms agree in general features, but differ in small details of spiculation. There is, however, nothing to justify a specific distinction, and such differences as are present amount to no more than the normal fluctuating variations.

DISTRIBUTION.—Australia (south and east coasts).

Crella incrustans, var. *digitata*, Hallmann.

C. incrustans, var. *digitata*, Hallmann, 1912, p. 156, pl. xxiii, fig. 2, text-figs. 28, 29.

OCCURRENCE.—Great Barrier Reef ; Savile Kent coll.

REMARKS.—The specimen has the external form of *C. incrustans*, var. *digitata*, and the spiculation of the var. *perramosa*.

DISTRIBUTION.—Tasmania.

Genus *Halichondria*, Fleming.

Halichondria, Fleming, 1828, p. 520 ; *Halispongia*, Blainville, 1830, p. 495 ; *Spuma*, Michlucho-Maclay, 1870, p. 13.

REMARKS.—The first species mentioned by Blainville as belonging to *Halispongia* is *Spongia papillaris*, Grant (= *Halichondria panicea*, Auctt.). This is here taken as the genolectotype, so that *Halispongia* becomes a synonym of *Halichondria*.

Spuma borealis, as figured by Michlucho-Maclay, is obviously identical with *Halichondria panicea*.

Halichondria phakellioides, Dendy and Frederick. (Plate II, fig. 1.)

H. phakellioides, Dendy and Frederick, 1924, p. 498, pl. xxxvi, fig. 10.

OCCURRENCE.—Great Barrier Reef ; Savile Kent coll.

REMARKS.—A single specimen, composed of a number of vertical lamellae set at varying angles to each other, agrees closely with the holotype. A second specimen in the British Museum collection was obtained from Swan River, W. Australia.

DISTRIBUTION.—Australia (west and south-west coasts).

Carterispongia elegans (Lendenfeld).

Phyllospongia elegans, Lendenfeld, 1889, p. 192, pl. v, fig. 4 ; pl. vii, fig. 2.

OCCURRENCE.—Great Barrier Reef ; Savile Kent coll.

REMARKS.—Three specimens were obtained, all of typical external form. In one

of them the usual sandy inclusions of the fibres and cortex are replaced by foreign sponge spicules.

Distribution.—Australia (west and east coasts).

Spongia officinalis, Linnaeus, var. *mollissima*, Schmidt.

Spongia mollissima, Schmidt, 1862, p. 23; *Spongia officinalis*, subsp. *mediterranea*, var. *mollissima*, Hyatt, 1877, p. 511, pl. xvi, fig. 21; *S. officinalis*, subsp. *mediterranea*, var. *zimocciformis*, *idem*, *l. c.*, p. 511; *Euspongia officinalis*, var. *mollissima*, Schulze, 1879, p. 616, pl. xxxv, figs. 1, 2; Lendenfeld, 1889, p. 268.

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—Two large massive sponges, the larger 25 cm. by 16 cm. by 12 cm. high, appear to agree closely with this variety.

Distribution.—Mediterranean.

Spongia lignea, Hyatt.

S. lignea, Hyatt, 1877, p. 515; *Euspongia officinalis*, var. *dura*, Lendenfeld, 1886, pp. 531, 533; *idem*, 1889, p. 275, pl. xii, fig. 2; pl. xxii, fig. 7.

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—Hyatt's original description leaves much to be desired, but the reference to the hard, cork-like texture of the sponge makes it almost certain that the present identification is correct.

Distribution.—Australia (east coast).

Spongia equina (Schmidt).

Euspongia equina, Schmidt, 1868, p. 4. (For further synonymy see Lendenfeld, 1889, pp. 302–8.)

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—A large subspherical sponge, 28 cm. in greatest diameter, so abundantly infested with barnacles that its identification is rendered uncertain. From the small areas of the sponge unaffected by the commensals, it appears to be *Spongia equina* (Schmidt).

Distribution.—Mediterranean; West Indies; Australia (all coasts).

Spongia zimocca, Schmidt.

S. zimocca, Schmidt, 1862, p. 23, pl. iv, figs. 3, 4; *Euspongia zimocca*, Schulze, 1879, p. 614, pl. xxxv, fig. 10; Lendenfeld, 1889, p. 261, pl. xxii, fig. 4; pl. xxxviii, fig. 6.

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—A single specimen, dorso-ventrally flattened, measuring 22 cm. by 14 cm. by 3 cm., seems to be identical with this species.

The species has been previously identified from Australia by Lendenfeld (*loc. cit.*).

Distribution.—Mediterranean; Australia (east coast).

Genus *Fasciospongia*, gen. n.

Genotype.—**Stelospongia australis*, var. *fovea*, Lendenfeld, 1889, p. 518.

Diagnosis.—Skeleton of stout, pithed fibres; primary fibres forming well-marked fasciated systems, each connected to neighbouring systems by a loose reticulation of secondary fibres; primary fibres cored by a weak line of broken sponge spicules; no special dermal skeleton.

Remarks.—In the structure of the fibres and the nature of the inclusions in the primary fibres, this species agrees with *Cacospongia* (see Topsent, 1929, pp. 9–10, text-figs. 2, 3). The distinction of the new genus depends on the fact that the primary systems run to the surface and are connected by an irregular system of secondary fibres.

The structure of the fasciated fibres is seen well in *Stelospongia costifera*, Lendenfeld, and *S. pulcherrima*, Lendenfeld, both of which must be regarded as belonging to *Fasciospongia.*

Fasciospongia fovea (Lendenfeld).

Stelospongia australis, var. *fovea*, Lendenfeld, 1889, p. 518, pl. xxiv, fig. 8; pl. xxv, fig. 4; pl. xxxi, figs. 7, 9; pl. xxxii, fig. 9.

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—This species is tolerably well figured by Lendenfeld. His pl. xxxi, fig. 7, shows the conspicuous nature of the fasciated primary fibres, but unfortunately Lendenfeld figures them as a series of straight lines instead of an intricate system of anastomosing and connected fibres. *Cacospongia amorpha*, Poléjaeff, is, contrary to Lendenfeld's assertion, not a synonym of the present species.

Distribution.—Australia (all coasts).

Genus *Euryspongia*, Row.

Genotype.—*E. lactea*, Row, 1911, p. 366, pl. xxxix, fig. 23; pl. xli, figs. 27, 28.

Diagnosis.—Skeleton composed of primary fibres, often cored with sand-grains, and connected by an irregular reticulation of secondary fibres; fibres laminated, non-pithed (?); no special dermal skeleton.

Euryspongia canalis (Lendenfeld).

Stelospongia canalis, Lendenfeld, 1889, p. 495, pl. xxiv, fig. 10; pl. xxix, figs. 2, 4, 5, 7; pl. xxxi, fig. 1; pl. xxxii, fig. 6.

Occurrence.—Great Barrier Reef; Savile Kent coll.

Remarks.—There is little to add to the original description, except that the main fibres

* Genus *Stelospongos*, Schmidt.

Stelospongos, Schmidt, 1870, p. 29; *Stelospongia*, Schulze, 1879, p. 613; *Stelospongus*, Carter, 1885, p. 303.

Remarks.—The genus *Stelospongos* was founded by Schmidt but no species were named, and the diagnosis given is hopelessly inadequate. The name is therefore a *nomen nudum.* Unfortunately, under a revised spelling, it was made popular by Schulze and Lendenfeld, and has been used for a number of species of horny sponges, of which the only common feature is a fibre of stiff texture when dried.

often contain an axial filling of sand-grains, and that the description of the connecting fibres given by Lendenfeld is incorrect. He says, " The skeleton consists of simple main fibres, which are joined by simple or slightly branched connecting fibres." In actual fact the connecting fibres form a very irregular network between the main fibres, and it is this, coupled with the structure of the fibres, that determines the resemblance of this species to *Euryspongia lactea*, Row.

A second specimen in the British Museum collection is labelled Swan River (West Australia).

Distribution.—Australia (south, east and west coasts).

II. Callyspongia ramosa (Gray).

Callyspongia ramosa (Gray).

Spongia ramosa, Gray, 1843, p. 295; *Pachychalina ramosa*, Dendy, 1898, p. 318, pl. xxxiii; *Chalina polychotoma*, var. *trichotoma*, Carter, 1885, p. 115; *Cladochalina nuda*, Ridley, 1884, p. 395, pl. xli, fig. I; *C. nuda*, var. *abruptispicula*, *idem*, *l. c.*, p. 396, pl. xli, fig. J; *Toxochalina robusta*, Ridley and Dendy, 1887, p. 50 (*nec T. robusta*, Ridley); *Chalinopora paucispina*, Lendenfeld, 1887, p. 765; *Cladochalina dendroides*, *idem*, *l. c.*, p. 769, pl. xix, fig. 21; *C. mammillata*, *idem*, *l. c.*, p. 769; *C. tenuirhaphis*, *idem* *l. c.*, p. 769, pl. xix, fig. 24; *Pachychalina paucispina*, *idem*, *l. c.*, p. 776; *P. ramulosa*, et varr. *lamella* et *digitata*, *idem*, *l. c.*, p. 777, pl. xix, fig. 22; *P. macrospina*, *idem*, *l. c.*, p. 777; *P. elegans*, *idem*, *l. c.*, p. 777, pl. xix, fig. 18; *P. rigida*, *idem*, *l. c.*, p. 778, pl. xix, fig. 14; *P. oculata*, *idem*, *l. c.*, p. 778; *Ceraochalina papillata*, et varr. *macropora*, *intermedia* et *micropora*, *idem*, *l. c.*, pp. 780, 781, pl. xix, fig. 16; *C. nuda*, et varr. *oxyus* et *oxystrongylus*, *idem*, *l. c.*, pp. 781, 782; *C. levis*, *idem*, *l. c.*, p. 782, pl. xix, fig. 19: *C. microrhaphis*, *idem*, *l. c.*, p. 783; *C. multiformis*, et varr. *maeandra*, *elegans*, *lamella*, *digitata*, *mollis* et *dura*, *idem*, *l. c.*, pp. 783, 784, pl. xix, figs. 15, 20, 23, 25; pl. xxvii, figs. 4, 25; *C. tenella*, *idem*, *l. c.*, p. 785; *C. reteplax*, *idem*, *l. c.*, p. 785, pl. xix, fig. 17; *C. euplax*, *idem*, *l. c.*, p. 785, pl. xix, fig. 13; *C. extrema*, *idem*, *l. c.*, p. 785; *Dactylochalina mollis*, *idem*, *l. c.*, p. 812; *D. candelabrum*, *idem*, *l. c.*, p. 812; *D. conulata*, *idem*, *l. c.*, p. 813, pl. xviii, fig. 2; *D. australis*, *idem*, *l. c.*, p. 813; *Euchalinopsis dendroides*, *idem*, *l. c.*, p. 816, pl. xviii, fig. 8; *E. minima*, *idem*, *l. c.*, p. 816, pl. xviii, fig. 3; *Euchalina typica*, *idem*, *l. c.*, p. 817, pl. xviii, fig. 5; pl. xxvii, fig. 24; *E. paucispina*, *idem*, *l. c.*, p. 818; *E. macropora*, *idem*, *l. c.*, p. 818; *E. exigua*, et varr. *simplex* et *arborea*, *idem*, *l. c.*, p. 818, pl. xviii, figs. 6, 10; *E. phillippinensis*, *idem*, *l. c.*, p. 819; *Toxochalina difficilis*, Brøndsted, 1923, p. 132, fig. 14; *Chalina oculata*, var. *novae-zealandiae*, Dendy, 1924, p. 326; *Ceraochalina pergamentacea*, *idem*, *l. c.*, p. 327; *Pachychalina affinis*, Brøndsted, 1924, p. 455, fig. 13; *Toxochalina chalmeri*, *idem*, 1926, p. 5, fig. 4; *Cladochalina dendyi*, Burton, 1929, p. 421.

Diagnosis.—Sponge typically branching and erect, with oscules in linear series along margins of branches or scattered over faces of branches; oscules level with surface, mammillate or incipiently fistulous (collar-like margins); branches rounded or flattened, with tendency to fuse, forming irregularly massive or flabellate individuals; main skeleton a regular network with ascending fibres bi- or multispicular, conjunctive fibres usually unispicular; dermal skeleton of small, primary meshes, subdivided into a few secondary meshes, usually unispicular, sometimes echinated; spicules oxea, with abruptly pointed ends, ·03 to ·1 by ·002 to ·01 mm.; toxa, often absent, ·03 to ·1 mm. chord.

Remarks.—*Spongia ramosa*, Gray, was re-described by Dendy (1898, *loc. cit.*) from four specimens from New Zealand. These were divided into two varieties, quite unnecessarily, as can now be seen. The sponges are erect, with long, cylindrical branches bearing numerous small oscules level with the surface, sometimes arranged in linear series along the sides of the branches, sometimes scattered generally over the surface of the sponge. The external form, therefore, resembles closely that of *Haliclona oculata* (Pallas).

The skeleton is differentiated into main and dermal portions, the latter being readily detachable from the outer ends of the ascending fibres of the main skeleton. The main skeleton consists of the usual quadratic mesh of spiculo-fibre, the ascending (primary) fibres being cored by a somewhat plumose series of spicules and the conjunctive (secondary) fibres by a linear series of single spicules. The dermal skeleton is unispicular throughout, and resembles, almost exactly, that of *Callyspongia fallax,* Duchassaing and Michelotti. The spicules are oxea, ·04 by ·005 mm., nearly straight, and abruptly pointed at each end. The lectotype of the species is specimen A (Dendy, *loc. cit.*, pl. xxxiii). The remaining three specimens differ so little in the main details of the skeleton, external form, texture, etc., that it is unnecessary to say anything more on this point, and it is most emphatically a waste of time to attempt to divide them into varieties. Two points may, however, be noted. In specimen B (B.M. 42.12.2.122) the dermal skeleton is echinated as in the type of *Patuloscula* (*cf.* p. 542, Text-fig. 6), and a few, very rare, toxa are present in the meshes of the dermal skeleton. This at first sight would appear to suggest a varietal, or even specific difference. In fact, if we were to attempt to maintain our old ideas of classification, the lectotype would be placed in the genus *Chalina*, or *Pachychalina* (according to the taste of the author), and specimen B in the genus *Toxochalina.* Further, specimen B is so like specimen C in all essential details that no one would hesitate to pronounce them identical, yet specimen C, although possessing very rare toxa, has a dermal skeleton which is not echinated. Moreover, while both specimen B and specimen C are in all other respects indistinguishable from it, the lectotype has a non-echinated dermal skeleton, and is without toxa. We have to be prepared, therefore, to regard the presence or absence of toxa, and the presence or absence of echinating spicules in the dermal skeleton, as features without taxonomic significance.

Dendy (*loc. cit.*, p. 318) included, as a synonym of *Chalina* (*Spongia*) *ramosa* (Gray), *Ceraochalina levis,* Lendenfeld. The specimens, three in number, described by Lendenfeld under this name are in the British Museum: The first (B.M. 86.10.27.436), from Port Chalmers, New Zealand, is a Sponge—Alga pseudomorph; the second (B.M. 86.8.27.443), the figured specimen (Lendenfeld, 1887, pl. xix, fig. 19), also from Port Chalmers, has the same appearance macro- and microscopically as the lectotype of *Spongia ramosa,* but the branches are twice as thick, the oxea are ·06 mm. long, though having the same characteristic shape, and the toxa, up to ·06 mm. chord, are abundant. The third specimen (B.M. 86.8.27.433), from Torres Straits, Australia, is indistinguishable externally from the second specimen and has the same arrangement of the fibres in the skeleton. Toxa are, however, absent, and the oxea measure only ·04 by ·002 mm., as against ·06 by ·004 mm. The oxea have not, moreover, the abruptly-pointed ends, but every now and then one finds an occasional stouter oxeote with the characteristic shape. In all probability these two specimens are conspecific, yet, according to present ideas, one is a *Ceraochalina* and the other a *Toxochalina.* Whether they can really be considered identical is a little doubtful on account of the geographical separation, but this is a point to which reference will be made later. At all events, specimen 2, the figured specimen, is the lectotype, and this is certainly identical with *Chalina* (*Spongia*) *ramosa* (= *Callyspongia ramosa*, Gray, on account of the structure of the dermal skeleton).

Since Lendenfeld's time, Brøndsted has described several species from New Zealand. One of these, *Toxochalina chalmeri,* from Port Chalmers, is, although I have not seen the

specimen, unquestionably identical with the lectotype of *Ceraochalina levis*, Lendenfeld (= *Callyspongia ramosa* (Gray)). Similarly, there can be no question that *Toxochalina difficilis*, Brøndsted, from Carnley Harbour, New Zealand, is also of the same identity, although the oxea measure ·08 by ·009 mm. Moreover, *Pachychalina affinis*, a piece of which I have been able to examine, through the kindness of Dr. Brøndsted, differs from the type of *Callyspongia ramosa* only in that the meshes of the dermal skeleton are larger, and the oxea measure ·07 by ·006 mm. The latter have, however, the characteristic shape, the ends being more pronouncedly abrupt than is shown in Brøndsted's figure (1924, p. 454, fig. 13). Further, the typical toxa are present, though in very small numbers, but because there are so many foreign spicules in (or on ?) the dermis of this specimen, their significance was not readily apparent.

It will be useful at this juncture to quote Brondsted's remarks, made *à propos* of his *Toxochalina difficilis* : " Here we have one of the many cases where the difficulties in classifying amongst the *Monaxonida* are clearly seen. The structure of the skeleton as well as the shape of the oxea are exactly as in *Chalina* ; while the sponge, if the microscleres are to be decisive for classification, is to be included amongst the *Gelliinae*.

" Although it is most natural, in my opinion, to place *Toxochalina* among the *Chalininae*, I here still refer it to the *Gelliinae* which I find most practical. As well known, it is impossible to find a usable limit between ' greater ' and ' lesser ' amount of spongin, while the diagnosis ' microscleres present ' and ' microscleres absent ' is an absolute distinction, and therefore practical. Sooner or later the genus, however, will be included among the *Chalininae* ; we often see that microscleres appear in separate groups independent of one another, groups in which the primordial forms all are devoid of microscleres. But as yet it would be to break up the well-defined *Chalinine*-group, if we include in it the genus *Toxochalina*." The following observations will show how justified are these remarks, and will perhaps clear up some of the doubts expressed therein. On one point, however, I disagree with Brøndsted—that concerning the value of the presence or absence of microscleres as a diagnostic feature. This is not an " absolute distinction " as the present paper shows, and as I have seen over and over again in examining specimens in the British Museum collection. Indeed, it is to the acceptance by nearly all authors of this false premise that so many of our difficulties are due.

Returning now to the synonymy of *Callyspongia ramosa* (Gray), it happened that in examining the types of *Ceraochalina levis*, Lendenfeld, my attention was drawn to the similarity to Gray's species of many of the species described by Lendenfeld in his ' Chalineen des Australischen Gebietes,' the book on which our present classification of the Chalininae (if not the Haploscleridae) is mainly based. Subsequent investigations, the results of which are given below, showed that many of these species are undoubtedly synonymous with *Callyspongia ramosa* :

1. *Cladochalina dendroides* (Port Chalmers) : External form typical, but branches slightly flattened. Margins of oscules produced into collar-like extensions. Skeleton generally typical, but dermal skeleton echinated. Oxea, of characteristic shape, ·07 by ·006 mm., and toxa abundant, up to ·07 mm. chord. Lendenfeld overlooked the toxa, which are very conspicuous, and described the megascleres as " Oxyus gerade . . . 0,05 mm. lang und 0,004 mm. dick."

2. *Cladochalina mammillata* (Port Chalmers) : Described as " Unregelmässig lappige Schwämme mit Erhebungen, auf deren Gipfel . . . weiten Oscula liegen " The

truth is that the type (and only specimen!) has virtually the same shape as *Cladochalina dendroides*, but the branches have coalesced and the oscules become mammilliform. The skeleton is typically that of *Callyspongia ramosa*, with a few toxa present. The oxea are mainly ·07 by ·003 mm. (not ·053 by ·005 as Lendenfeld says), with here and there stouter forms, ·07 by ·006 mm. (*cf. supra*, *Ceraochalina levis* specimen 3, p. 604).

3. *Cladochalina tenuirhaphis* (Port Chalmers): This provides a striking transition from a form like *Cladochalina dendroides* to *C. mammillata*, the coalescence of the branches being only partial. The same dermal skeleton is present as in those two species, and in every way the identity of *C. tenuirhaphis* with *Callyspongia ramosa* is obvious. The only differences of note are the absence of toxa and a variability in the size of the oxea. These vary from ·07 by ·002 mm. to ·07 by ·005 mm. (according to Lendenfeld they are all ·05 by ·002 mm.), the thickest being as numerous as the thinnest, and all transitions between the two extremes being present. Moreover, the thicker spicules have the characteristically abrupt points.

4. *Pachychalina paucispina* (New Zealand; no other locality given): It will always be a mystery why Lendenfeld should have named this species "*paucispina*." The external form is practically identical with that of specimen B of *Spongia ramosa*, Gray (*cf.* Dendy, 1897, pl. xxxiii, fig. B), and the skeleton also, except that the oxea measure ·07 by ·007 mm. and toxa are abundant.

5. *Pachychalina ramulosa* (New Zealand; no other locality given): (*a*) Var. *lamella*. If we could imagine specimen B of *Spongia ramosa*, Gray, with more numerous and broader branches, some of which had coalesced at certain points, we should have a specimen identical with the type of *Pachychalina ramulosa*, var. *lamella*. For the rest, all features agree with those of the lectotype of *Callyspongia ramosa*, except that the oxea measure ·07 by ·003 to ·005 mm. (*b*) Var. *digitata* is absolutely typical of *Callyspongia ramosa*, except that the oxea measure ·06 by ·005 mm.*

6. *Pachychalina macrospina* (Port Chalmers): The naming here is an even greater mystery! The surface throughout is smooth, even, and totally devoid of spines. Lendenfeld describes the sponge as "Klein, abgeflacht". In reality, the type consists of two small fragments of a flattened branch such as might have belonged to a specimen like *P. ramulosa*, var. *lamella* (see above). The skeleton is quite typical, the oxea measuring ·07 by ·004 mm. for the most part, with occasional forms measuring ·07 by ·007 mm. Lendenfeld gives as measurements, ·059 by ·007 mm., and says the spicules are "Nicht sehr zahlreich." This last statement may have been in comparison with a totally different type of "*Pachychalina*" in which the fibres were multispicular. Certainly, the spicules in *P. macrospina* are as numerous as in *Callyspongia ramosa*. Toxa, too, may be found, but rarely.

7. *Pachychalina elegans* (Port Chalmers): The species is intermediate between the lectotype of *Callyspongia ramosa* and *Pachychalina ramulosa*, var. *lamella*, in external form (*cf.* Lendenfeld, 1887, pl. xix, fig. 18); and the skeleton is typical, except that toxa are abundant and the oxea measure ·06 by ·004 mm. Lendenfeld says the oxea are "zahlreich", but again, this must be the result of comparison with a totally different type of sponge.

* In this specimen the oxea are often converted to styli or stronglya by the rounding off of one or both ends. This feature may also be seen in every specimen so far discussed, though to a variable extent.

8. *Pachychalina rigida* (New Zealand, no other locality given): This is another semi-lamellate form (*cf. P. elegans* and *P ramulosa*, var. *lamella*; see also Lendenfeld, *l. c.*, pl. xix. fig. 14). The skeleton is typical, except that the oxea are differentiated into two sizes, ·06 by ·004 and ·07 by ·008 mm., with occasional intermediates, and toxa are abundant. The specimen is less rigid than most of those discussed so far, and of a softer texture than any!

9. *Ceraochalina papillata*, var. *macropora* (New Zealand: no other locality given): The type differs from the lectotype of *Callyspongia ramosa* in having slightly more flattened branches, with more numerous oscules, which are, however, of the same diameter. The skeleton is typical, except that the oxea measure ·06 by ·003 to ·005 mm.

10. *Ceraochalina papillata*, var. *intermedia* (Port Chalmers): The only differences between the type of this variety and the lectotype of *Callyspongia ramosa* are that the branches are double the size, the dermal skeleton is echinated (as in one of the paratypes), and the oxea measure ·06 by ·003 mm.

11. *Ceraochalina papillata*, var. *micropora* (New Zealand; no other locality given): The type is a smaller specimen than that of the var. *macropora*, and the oscules have, in some cases, collar-like margins. If anything, the oscules are smaller, but not sufficiently so to justify a distinction into micro- and macroporous varieties.

12. *Ceraochalina levis* (Port Chalmers and Torres Straits): See above, p. 604.

13. *Ceraochalina microrhaphis* (Port Chalmers): This species differs from *Pachychalina ramulosa*, var. *lamella*, in one feature only—that the fibres of the dermal skeleton are echinated (*cf.* p. 603).

14. *Ceraochalina multiformis*.

(*a*) Var. *moeandra* (Port Chalmers): Lendenfeld's description of this variety and the name he gives it is misleading. The type consists of five flattened branches, arising from a common base, which have coalesced in somewhat irregular manner, giving rise to a sub-clathrous rather than a maeandrine individual. The form of the sponge is, however, typical but irregular. The skeleton is typical, with oxea usually ·04 by ·003 mm., but varying in diameter up to ·007 mm. and no toxa. The dermal skeleton is echinated.

(*b*) Var. *lamella* (New Zealand: no other locality given): The type is flabellate, with prominent oscules around the margins; such a specimen as might be formed by the fusion of a number of long tubes lying in one plane. At first sight, one is inclined to regard this sponge as belonging to different species from that under discussion, but there can be little doubt that it is merely an aberrant form of *Callyspongia ramosa* (Gray). The skeleton is practically identical with that of the lectotype of Gray's species, and with transitions to this flabellate form to be found already (*cf. Pachychalina ramulosa*, var. *lamella*), there is little need for doubt that *Ceraochalina multiformis*, var. *lamella*, must also be regarded as a synonym of *Callyspongia ramosa*.

(*c*) Var. *digitata* (Port Chalmers, Chatham Islands): The specimen from Port Chalmers is intermediate in external form between *Cladochalina tenuirhaphis* and *Cladochalina mammillata* (see above). Actually, one face of the sponge is identical in appearance with the first species and the other side with the other species. The skeleton is typical, the oxea measuring mostly ·07 by ·002 mm., but with numerous forms measuring ·007 mm. thick. The specimen from Chatham Islands (see Lendenfeld, 1887, pl. xix, fig. 20) is sub-flabellate and consists of flattened branches lying in one plane, many of the branches

being fused for the greater part of their length. The skeleton is identical with that of the Port Chalmers specimen.

(*d*) Var. *mollis* (Port Chalmers): The external form is not "fächerformig," but practically identical with that of *Cladochalina tenuirhaphis* (see above). The skeleton is typical, and the oxea ·06 by ·003 mm.

(*e*) Var. *dura* (Port Chalmers): The external form is flabellate and very like that of *Ceraochalina microrhaphis* (see above). The skeleton is quite typical and the oxea measure ·06 by ·003 to ·008 mm. (not ·0009 as stated).

15. *Ceraochalina reteplax* (Port Chalmers): The type is a piece of a branch, larger than is usual for *Callyspongia ramosa*, but showing all the essential characteristics of that species. The skeleton is typical; the dermal skeleton is echinated, the oxea are of two sizes, ·07 by ·003 mm. and ·07 by ·007 mm., and the toxa are very rare.

16. *Ceraochalina euplax* (New Zealand, according to a label on the specimen): This again is an aberrant form, the shape being flabellate (*cf. C. multiformis*, var. *lamella*, *C. ramosula*, var. *lamella*, etc.). Nevertheless, the skeleton is typical, and the toxa are present, and from a consideration of all its characters there can be no doubt that the type of this species must be considered identical with *Callyspongia ramosa.*

17. *Ceraochalina extrema* (Port Chalmers): This species, like *Pachychalina macrospina*, is described from a small fragment of what must have been a typical specimen of *Callyspongia ramosa*. The author's description and measurements are very incorrect. For example, the spicules are ·008 mm. thick, not ·0008 mm., as stated.

18. *Dactylochalina candelabrum* (Port Chalmers): The type is essentially like the lectotype of *Spongia ramosa*, with the same dermal skeleton, oxea of typical form, ·07 by ·005 mm., and abundant toxa.

19. *Euchalinopsis minima* (Port Chalmers, Port Phillip, S. Australia and Torres Straits, N. Australia). The first specimen, from Port Chalmers, has the external form of specimen D (*Chalina ramosa* (Gray), Dendy, 1898, pl. xxxiii), but in all other respects resembles the lectotype of Gray's species, except that the oxea measure ·055 by ·002 to ·005 mm. The Port Phillip specimen is indistinguishable in every respect from the Port Chalmers specimen, while the Torres Straits specimen agrees with Dendy's (1905) specimen of *Chalina subarmigera* (= *Callyspongia bullata* (Lamarck)), except that it has no toxa.

20. *Euchalina paucispina* (Port Chalmers, Port Phillip, Port Jackson): The first specimen, the lectotype, from Port Chalmers, is a typical *Callyspongia ramosa* (Gray) with occasional toxa; the second, from Port Phillip, is also typical, but has very slender oxea and no toxa; and the third, from Port Jackson, is typical in every way, with very abundant toxa. In the third specimen, the toxa are much more abundant than the oxea, and it is incomprehensible that Lendenfeld should have overlooked them.

It has been suggested above that several of Lendenfeld's specimens from Australia might be conspecific with *Callyspongia ramosa*, and it is therefore desirable to make sure that the species is found in waters outside those of New Zealand and the Chatham Islands. The first specimen examined in this connection gives indubitable proof of the occurrence of the species at Mauritius. *Pachychalina oculata*, Lendenfeld (1887), has the external form of *Cladochalina mammillata* (see above), and has exactly the same type of main and dermal skeletons as the lectotype of *Callyspongia ramosa.* The oxea have the characteristic abruptly-pointed ends, and measure ·06 by ·007 mm., and toxa are abundant.

Further, the specimen of *Toxochalina robusta*, Ridley, from Bahia, identified by Ridley and Dendy (1887), is indistinguishable from some of the Port Chalmers specimens of *Callyspongia ramosa* (Gray), and the same may be said of *Cladochalina nuda*, Ridley (which has abundant toxa !), from Torres Straits. *C. nuda*, var. *abruptispicula*, is also conspecific with the Port Chalmers sponges, the name "*abruptispicula*" describing well the characteristic shape of the oxea of *Callyspongia ramosa*.

Among the species described from Australia by Lendenfeld, the following are also synonymous with *C. ramosa* : from Victoria, *Ceraochalina tenella*, *Euchalina phillipensis*, *Dactylochalina australis*, *Ceraochalina multiformis*, var. *elegans*, and *Chalinopora pauci-spina* ; from New South Wales, *Euchalina exigua*, var. *simplex*, *E. macropora*, *E. typica*, *Euchalinopsis dendroides*, *Dactylochalina conulata* and *D. mollis* ; from Queensland, *Euchalina exigua*, var. *arborea*. All these species and varieties show the same characters and variation as the species described by Lendenfeld from Port Chalmers, and are obvious synonyms of *Callyspongia ramosa* (Gray). Lendenfeld's descriptions of them are often faulty and usually inadequate, and should be ignored. The only point to mention in connection with the Australian specimens is that in rare cases, when the megascleres are much reduced, their ends tend to become strongylote, but as the typical oxea are always present, though often in very small numbers, there is no taxonomic significance in this. *Ceraochalina pergamentacea*, Dendy (1924), is also a synonym of *Callyspongia ramosa*, the specimen being typical in structure and possessing toxa.

The distribution of *Callyspongia ramosa* also extends to the Antarctic, as is shown by a typical specimen from McMurdo Sound in the British Museum collection, and by the fact that *Cladochalina dendyi*, Burton (1929), is synonymous with it.

The sponge wrongly identified by Dendy (1924, p. 328) as *Siphonochalina communis* differs from *Callyspongia ramosa* in one respect only—that the external form is tubular, and it is very probable that this, too, must be considered a synonym of Gray's species.

LIST OF WORKS REFERRED TO.

Agassiz, J. L. R. 1846. Nomenclatoris Zoologici Index, 393 pp.

Annandale, N. 1915. Some Sponges Parasitic on Clionidae with Further Notes on that Family. Rec. Ind. Mus. Calcutta, XI, pp. 457–478, 1 pl., 5 figs.

Arndt, W. 1927. Kalk- und Kieselschwämme von Curaçao. Bijdr. Dierk. Amsterdam, XXV, pp. 133–158, 3 pls., 16 figs.

Babić, K. 1922. Monactinellida und Tetractinellida des Adriatischen Meeres. Zool. Jahrb., Syst. XLVI, pp. 217–302, 2 pls., 50 figs.

Blainville, M. H. D. de. 1830. (Article Zoophytes, Zoophyta.) Dict. Sci. Nat. LX, pp. 1–546.

—— 1834. Manuel d'actinologie ou de zoophytologie. Paris, pp. viii + 695, 103 pls.

Bowerbank, J. S. 1845. Observations on the Spongiadae. Ann. Mag. Nat. Hist. London, XVI, pp. 400–410, 2 pls.

—— 1862. On the Anatomy and Physiology of the Spongiadae. Philos. Trans. London, CLIII, pp. 747–829, 1087–1135, 12 pls.

—— 1864. A Monograph of the British Spongiadae, I. London, 8vo, 290 pp., 37 pls.

—— 1866. A Monograph of the British Spongiadae, II. London, 8vo, 388 pp.

—— 1872. Contributions to a General History of the Spongiadae. Proc. Zool. Soc. London, pp. 115–129, 196–202, 626–635, 8 pls.

—— 1874. A Monograph of the British Spongiadae, III. London, 8vo, 376 pp., 92 pls.

—— 1875. Contributions to a General History of the Spongiadae. Proc. Zool. Soc. London, pp. 281–296, 4 pls.

—— 1882. A Monograph of the British Spongiadae, IV. London, 8vo, 250 pp., 17 pls.

Brøndsted, H. V. 1923. Sponges from the Auckland and Campbell Islands. Vidensk. Medd. naturh. Foren. Kjøbenhavn, LXXV, pp. 117–167, 36 figs.

—— 1924. Sponges from New Zealand. Vidensk. Med. naturh. Foren. Kjøbenhavn, LXXVII, pp. 435–483, 33 figs.

—— 1926. Antarctic and Subantarctic Sponges collected by S. Wallin, 1924. Ark. Zool. Stockholm, 19A, 6, pp. 1–6, 4 figs.

Bronn, H. G. 1859. Die Klassen und Ordnungen des Thierreichs. Leipzig and Heidelberg, 8vo, 142 pp., 12 pls.

Burton, M. 1924. The Genus *Chondrilla.* Ann. Mag. Nat. Hist. London, XIV, pp. 206–209.

—— 1924. A Revision of the Sponge Family Donatiidae. Proc. Zool. Soc. London, pp. 1033–1045, 1 pl.

—— 1926. Observations on some British Species of Sponges belonging to the Genus *Reniera.* Ann. Mag. Nat. Hist. London, XVII, pp. 415–424.

—— 1926. Sponges [in] Zoological Results of the Suez Canal Expedition. Trans. Zool. Soc. London, XXII, pp. 71–83, 7 figs.

—— 1926. *Stelletta purpurea*, Ridley, and its variations. Ann. Mag. Nat. Hist. London, XVIII, pp. 44–49.

—— 1926. The Relation between Spongin and Spicule in the Haploscleridae. Ann. Mag. Nat. Hist. London, XVIII, pp. 265–267.

—— 1927. A Revision of the Genera and Species contained in Lendenfeld's "Die Chalineen des australischen Gebietes," II. Ann. Mag. Nat. Hist. London, XX, pp. 502–512.

—— 1929. Porifera : Part II, Antarctic Sponges. Brit. Mus. ("Terra Nova") Rept. London, 4to, VI (4), pp. 393–458, 5 pls., 9 figs.

—— 1930. Additions to the Sponge Fauna of the Gulf of Manaar. Ann. Mag. Nat. Hist. London, V, pp. 665–676, 3 figs.

—— 1930. Norwegian Sponges from the Norman Collection. Proc. Zool. Soc. London, pp. 487–546, 2 pls., 8 figs.

—— 1931. The Interpretation of the Embryonic and Post-Larval Characters of certain Tetraxonid Sponges. Proc. Zool. Soc. London, pp. 511–525, 1 pl., 6 figs.

Carter, H. J. 1873. On Two New Species of Gummineae, with Special and General Observations. Ann. Mag. Nat. Hist. London, XII, pp. 17–30, 1 pl.

—— 1876. Descriptions and Figures of Deep-sea Sponges. Ann. Mag. Nat. Hist. London, XVIII, pp. 226–240, 307–324, 388–410, 458–479, 5 pls.

—— 1880. Report on Specimens dredged up from the Gulf of Manaar. Ann. Mag. Nat. Hist. London, VI, pp. 35–61, 129–156, 5 pls.

—— 1881. Supplementary Report on Specimens dredged up from the Gulf of Manaar. Ann. Mag. Nat. Hist. London, VII, pp. 361–385, 1 pl.

—— 1882. New Sponges, observations on old ones, and a proposed New Group. Ann. Mag. Nat. Hist. London, X, pp. 106–125, 2 figs.

—— 1882. Some Sponges from the West Indies and Acapulco. Ann. Mag. Nat. Hist. London, IX, pp. 266–301, 346–368, 2 pls.

—— 1883. Contributions to our Knowledge of the Spongida : Pachytragida. Ann. Mag. Nat. Hist. London, XI, pp. 308–329, 344–369, 6 pls.

—— 1884. Catalogue of Marine Sponges, collected by Mr. Jos. Willcox, on the West Coast of Florida. Proc. Acad. Nat. Sci., Philadelphia, pp. 202–209.

—— 1885. Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia. Ann. Mag. Nat. Hist. London, XV, pp. 107–117, 196–222, 301–321 ; XVI, pp. 277–294, 347–368, 1 pl.

—— 1886. Descriptions of Sponges from the Neighbourhood of Port Phillip Heads, South Australia. Ann. Mag. Nat. Hist. London, XVII, pp. 40–53, 112–127, 431–441, 502–516 ; XVIII, pp. 34–55, 126–149.

—— 1886. Supplement to the Descriptions of Mr. J. Bracebridge Wilson's Australian Sponges. Ann. Mag. Nat. Hist. London, XVIII, pp. 271–290, 369–379, 445–466, 1 pl.

Delage, Y. 1899. Spongiaires [in] Delage and Hérouard, Traité de Zoologie concrète, II (1), pp. 49–244, 12 pls.

de Laubenfels, M. W. 1932. The Marine and Fresh-water Sponges of California. Proc. U.S. Nat. Mus., Washington, LXXXI (4), pp. 1–140, 79 figs.

Dendy, A. 1889. Report on a Second Collection of Sponges from the Gulf of Manaar. Ann. Mag. Nat. Hist. London, III, pp. 73–99, 3 pls.

—— 1890. Observations on West Indian Chalinine Sponges. Trans. Zool. Soc. London, XII, pp. 349–368, 6 pls.

—— 1892. Synopsis of the Australian Calcarea Heterococla. Proc. Roy. Soc. Victoria, V, pp. 69–116.

Dendy, A. 1895. Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A. Proc. Roy. Soc. Victoria, VII, pp. 232–260.
—— 1896. Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A. Proc. Roy. Soc. Victoria, VIII, pp. 14–51.
—— 1897. Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A. Proc. Roy. Soc. Victoria, IX, pp. 230–259.
—— 1898. On the Sponges Described in Dieffenbach's 'New Zealand.' Trans. N.Z. Inst. XXX, pp. 316–320, 2 pls.
—— 1905. Report on the Sponges collected by Prof. Herdman at Ceylon. Rep. Pearl Oyster Fish., Suppl. XVIII, pp. 57–246, 16 pls.
—— 1913. Report on the Calcareous Sponges collected by H.M.S. "Sealark" in the Indian Ocean. Trans. Linn. Soc. London, Zool. XVI, pp. 1–29, 5 pls.
—— 1916. Report on the Non-Calcareous Sponges collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905–6. Rep. Govt. Baroda Marine Zool., Okhamandal, II, pp. 93–146, 4 pls.
—— 1921. Report on the Sigmatotetraxonida collected by H.M.S. "Sealark" in the Indian Ocean. Trans. Linn. Soc. London, Zool. XVIII, pp. 1–164, 18 pls.
—— 1924. Porifera: Part I. Brit. Mus. ("Terra Nova") Rept. London, VI (3), pp. 269–392, 15 pls.
—— and Frederick, L. M. 1924. On a Collection of Sponges from Abrolhos Islands, Western Australia. J. Linn. Soc. London, XXXV, pp. 477–518, 1 pl.
—— and Row, R. W. H. 1913. The Classification and Phylogeny of the Calcareous Sponges, with a Reference List of all the Described Species, Systematically Arranged. Proc. Zool. Soc. London, pp. 704–813.
Dragnewitsch, P. 1905. Spongien von Singapore. Inaug. Dissert., Bern, 36 pp.
Duchassaing, F. de, and Michelotti, G. 1864. Spongiaires de la Mer caraïbe. Natuurk. verh. Mij. Haarlem, XXI, pp. 1–124, 25 pls.
Ehlers, E. 1870. Die Esper'schen Spongien. Erlangen, 4to, 36 pp.
Ellis, J., and Solander, D. 1786. The Natural History of Many Curious and Uncommon Zoophytes. London, 4to, 208 pp., 63 pls.
Esper, E. J. C. 1794. Die Pflanzenthiere, II. Nürnberg, 4to, 303 pp., 49 pls.
Fleming, J. 1828. A History of British Animals. Edinburgh, London, 8vo, xxiii, 565 pp.
Grant, R. 1841. Outlines of Comparative Anatomy. London, 8vo, 656 pp.
—— 1861. Tabular View of the Primary Divisions of the Animal Kingdom. London, 8vo, vi, 91 pp.
Gray, J. E. 1843. Catalogue of Radiated Animals. Travels in New Zealand (Dieffenbach), II, p. 264.
—— 1867. Notes on the Arrangement of Sponges. Proc. Zool. Soc. London, pp. 492–558.
—— 1869. Note on *Ianthella*, a New Genus of Keratose Sponges. Proc. Zool. Soc. London, pp. 49–51.
Gray, S. F. 1821. A Natural Arrangement of British Plants, I. London, 8vo, 824 pp., 21 pls.
Haeckel, E. 1869. Prodromus eines Systems der Kalkschwämme. Jena. Z. Naturw. V, pp. 235–254.
—— 1872. Die Kalkschwämme: eine Monographie, I and II, and Atlas, Berlin.
Hallman, E. F. 1912. Report on the Sponges obtained by the F.I.S. "Endeavour." Part I: Commonwealth of Australia Fisheries. Zool. Res. Fish. Exper. "Endeavour," 1909–10, II, pp. 115–300, 6 pls., 48 figs.
—— 1920. New Genera of Monaxonid Sponges related to the Genus *Clathria*. Proc. Linn. Soc. N.S. Wales, XLIV, pp. 767–792, 5 pls., 3 figs.
Hentschel, E. 1909. Tetraxonida, I. Fauna S.W.-Australiens, von W. Michaelsen, II (21), Jena, pp. 347–402, 2 pls., 29 figs.
—— 1911. Tetraxonida, II. Fauna, S.W.-Australiens, von W. Michaelsen, III (10), pp. 279–393, 54 figs.
—— 1912. Kiesel -und Hornschwämme der Aru- und Kei-Inseln. Abh. Senckenb. naturf. Ges. Frankfurt-a-M. XXXIV, pp. 291–448, 9 pls.
—— 1914. Monaxone Kieselschwämme und Hornschwämme der Deutschen Südpolar-Expedition 1901-1903. Deutsche Südpolar-Expedition, XV (Zool. 7), pp. 37–141, 5 pls.
Houthuyn, M. 1772. Natuurlyke historie, of uitvoerige beschryving der Dieren, Planten en Mineralen. Amsterdam, 8vo, I.
Hyatt, A. 1877. A Revision of the North American Poriferae. Mem. Boston Soc. Nat. Hist. II, pp. 481–554, 3 pls.
Johnston, G. 1842. A History of British Sponges and Lithophytes. London, Edinburgh, Dublin, 8vo, 264 pp., 25 pls.

KELLER, C. 1879. Studien über Organization und Entwicklung der Chalineen. Z. wiss. Zool., XXXIII, pp. 317–349, 3 pls.
—— 1889. Die Spongienfauna des rothen Meeres. Z. wiss. Zool. XLVIII, pp. 311–405, 5 pls.
—— 1891. Die Spongienfauna des rothen Meeres. Z. wiss. Zool. LII, pp. 294–368, 5 pls.
KIESCHNICK, O. 1896. Silicispongiae von Ternate. Zool. Anz. XIX, pp. 526–534.
—— 1900. Kieselschwämme von Amboina. Denkschr. med.-naturw. Ges. Jena, VIII, pp. 545–582, 2 pls.
KIRKPATRICK, R. 1900. Description of Sponges from Funafuti. Ann. Mag. Nat. Hist. London, VI, pp. 345–362, 3 pls.
—— 1900. On the Sponges of Christmas Island. Proc. Zool. Soc. London, pp. 127–141, 2 pls.
KÖLLIKER, A. 1864. Icones histologicae, oder Atlas der vergleichenden Gewebelehre. Abth. I. Leipzig, 4to, pp. 46–74, 2 pls., 7 figs.
LAMARCK, J. B. P. DE M. 1815. Suite des polypiers empâtés. Mém. Mus. Paris, I, pp. 69–80, 162–168, 331–340.
—— 1816. Histoire naturelle des animaux sans vertèbres. Paris, 4to, II, 568 pp.
LENDENFELD, R. VON. 1883. Ueber Coelenteraten der Südsee. Z. wiss. Zool. XXXVIII, pp. 234–313, 4 pls.
—— 1886. A Monograph of the Australian Sponges, V and VI. Proc. Linn. Soc. N.S.W. X (3), pp. 282–325, 481–553, 13 pls.
—— 1886. Studies on Sponges. Proc. Linn. Soc. N.S.W., X, pp. 557–574, 6 pls.
—— 1887. Die Chalineen des australischen Gebietes. Zool. Jahrb. II, pp. 723–828, 10 pls.
—— 1888. Descriptive Catalogue of the Sponges in the Australian Museum, Sydney. London, 8vo, 260 pp., 12 pls.
—— 1889. A Monograph of the Horny Sponges. London, 4to, 936 pp., 50 pls.
—— 1897. Spongien von Sansibar. Abh. Senckenb. Naturf. Ges. XXI, pp. 93–133, 2 pls.
—— 1903. Tetraxonia [in] Das Tierreich, XIX, pp. 1–168, 44 figs.
—— 1906. Tetraxonia. Wiss. Ergebn. Deutsch. Tiefsee-Exped. XI (2), Jena, pp. 59–373.
LEVINSEN, G. M. R. 1887. Un coup d'oeil sur la faune de la mer de Kara. C. F. Lütken. Dijmphna-Togtets zool. Bot. Udbytte Kjøbenhavn, pp. 512, 513, 3 pls.
LIEBERKÜHN, N. 1859. Neue Beitrage zur Anatomie der Spongien. Arch. Anat. Physiol., pp. 515–529, 3 pls.
LINDGREN, N. G. 1897. Beitrag zur Kenntniss der Spongienfauna des Malaiischen Archipels und der Chinesischen Meere. Zool. Anz. XX, pp. 480–487.
—— 1898. Beitrag zur Kenntniss der Spongienfauna des Malayischen Archipels und der Chinesischen Meere. Zool. Jahrb. (Abt. Syst.), XI, pp. 283–378, 4 pls.
LINNAEUS, C. 1759. Systema naturae, II, ed. 10.
—— 1767. Systema naturae, III, ed. 12.
MARSHALL, W. 1892. Spongiologische Beiträge. Festschrift 70, Wiederk. Geburtst. Leuckart, 4to, 36 pp., 8 pls.
MARTENS, G. M. VON. 1824. Reise nach Venedig. Ulm and Baiern, 8vo, 1136 pp.
MICHLUCHLO-MACLAY, N. 1870. Über einige Schwämme des nordlichen Stillen Oceans und des Eismeeres. Mém. Acad. Imp. St. Pétersbourg, XV (3), 24 pp., 2 pls.
MONTAGU, G. 1818. An Essay on Sponges. Mem. Werner. Soc. Edinburgh, II, pp. 67–122, 14 pls.
NARDO, G. D. 1833. Auszug aus einem neuen System der Spongiarien. Isis (Oken), Coll. 519–523.
—— 1834. De Spongiis. Isis (Oken), Coll. 714–716.
—— 1847. Prospetto della Fauna marina volgare del Veneto estuario. Estratto dall' opera : Venezia e le sue lagune, 45 pp.
NORMAN, A. M. 1869. Final Dredging Report. Part II : Rep. Brit. Ass. 38, pp. 247–336.
OKEN, L. 1815. Lehrbuch der Naturgeschichte. Jena, 4to, III (1).
PALLAS, P. S. 1766. Elenchus Zoophytorum. Nurnberg, 4to, pp. 28, 451.
POLÉJAEFF, N. 1883. Report on the Calcarea dredged by H.M.S. "Challenger." Rep. Sci. Res. Voy. "Challenger," Zool. VIII, pp. 1–76, 9 pls.
—— 1884. Report on the Keratosa collected by H.M.S. "Challenger." Rep. Sci. Res. Voy. "Challenger," Zool. XI, pp. 1–88, 10 pls.
RIDLEY, S. O. 1881. Spongida (Account of the Zoological Collections made during the Survey of H.M.S. "Alert"). Proc. Zool. Soc. London, pp. 107–137, 140–141, 2 pls.
—— 1884. Spongiida [in] Rep. Zool. Colls. Voy. H.M.S. "Alert," London, 8vo, pp. 366–482, 582–630, 6 pls.

RIDLEY, S. O. 1884. Notes on Sponges, with Description of a New Species. Ann. Mag. Nat. Hist. London. XIV, pp. 183–187.

—— and DENDY, A. 1886. Preliminary Report on the Monaxonida collected by H.M.S. "Challenger." Ann. Mag. Nat. Hist. London. XVIII, pp. 325–351.

—— —— 1887. Monaxonida. Rep. Sci. Res. Voy. "Challenger." Zool. XX, 275 pp., 51 pls.

ROW, R. W. H. 1911. Report on the Sponges collected by Mr. Cyril Crossland in 1904–5. Part II: Non-Calcarea. J. Linn. Soc. Lond., Zool. XXXI, pp. 287–400, 7 pls., 26 figs.

SCHMIDT, E. O. 1862. Die Spongien des adriatischen Meeres. Leipzig, 4to, 88 pp., 7 pls.

—— 1864. Supplement der Spongien des adriatischen Meeres. Leipzig, 4to, 48 pp., 4 pls.

—— 1868. Die Spongien der Küste von Algier. (Drittes Supplement.) Leipzig, 4to, 44 pp., 5 pls.

—— 1870. Grundzüge einer Spongien-Fauna des atlantischen Gebietes. Leipzig, fol., 88 pp., 6 pls.

SCHULZE, F. E. 1878. Untersuchungen über den Bau und die Entwicklung der Spongien. Z. wiss. Zool. XXX, pp. 379–420, 4 pls.; XXXII, pp. 117–157, 4 pls.

—— 1879. Untersuchungen über den Bau und die Entwicklung der Spongien. Z. wiss. Zool. XXXII, pp. 593–660, 5 pls.; XXXIII, pp. 1–38, 4 pls.

SELENKA, E. 1867. Ueber einige neue Schwämme aus der Südsee. Z. wiss. Zool. XVII, pp. 565–571, 1 pl.

SHAW, M. 1927. On a Collection of Sponges from Maria Island, Tasmania. Proc. Zool. Soc. London. pp. 419–439, 1 pl., 4 figs.

SIEBOLD, C. F. E. VON. 1843. Bericht über die Leistungen in der Naturgeschichte der Annulaten. Arch. Naturgesch., IX (2), pp. 289–299.

SOLLAS, I. B. J. 1902. On the Sponges collected during the Skeat Expedition. Proc. Zool. Soc. London, pp. 210–221, 2 pls.

SOLLAS, W. J. 1886. Preliminary Account of the Tetractinellid Sponges dredged by H.M.S. "Challenger," 1872–76. Part I: The Choristida. Sci. Proc. R. Dublin Soc. V, pp. 177–199.

—— 1888. Report on the Tetractinellida collected by H.M.S. "Challenger" during the Years 1873–6. Rep. Sci. Res. Voy. "Challenger," London, Zool. XXV, pp. 1–458, 54 pls.

STEPHENSON, T. A. (and others). 1931. The structure and ecology of Low Isles and other reefs. Brit. Mus. (Barrier Reef) Rept., III, 2, 112 pp., 27 pls., 15 figs.

TEMPLETON, J. 1836. A Catalogue of the Species of Rayed Animals found in Ireland. Mag. Nat. Hist. IX, pp. 466–472.

THIELE, J. 1899. Studien über Pazifische Spongien. Zoologica, XXIV, pp. 1–33, 5 pls.

—— 1903. Kieselschwämme von Ternate. Abh. Senckenb. naturf. Ges., Frankfurt-a-M. XXV, pp. 933–968, 1 pl.

—— 1905. Die Kiesel- und Hornschwämme der Sammlung Plate. Zool. Jahrb. Jena, Suppl. VI, pp. 407–496, 114 figs.

TOPSENT, É. 1891. Essai sur la Faune des Spongiaires de Roscoff. Arch. Zool. expér. IX, pp. 523–554, 1 pl.

—— 1891. Deuxième Contribution a l'Étude des Clionides. Arch. Zool. expér. IX, pp. 555–592, 1 pl.

—— 1892. Éponges de la Mer Rouge. Mém. Soc. Zool. Fr. V, pp. 21–29, 1 pl.

—— 1897. Spongiaires de la Baie d'Amboine. Rev. suisse Zool. IV, pp. 421–487, 4 pls.

—— 1900. Étude monographique des Spongiaires de France. III: Monaxonida. Arch. zool. expér. VIII, pp. 1–331, 8 pls.

—— 1908. Spongiaires [in] Expéd. Antarctique française (1903–1905), pp. 1–37, 5 pls.

—— 1917. Spongiaires [in] 2me Expéd. Antarctique française (1908–1910), pp. 1–88, 6 pls.

—— 1918. Éponges de San Thomé. Arch. zool. expér. LVII, pp. 535–618, 28 figs.

—— 1920. *Tethya aurantium* (Pallas) et les Tethya de Lamarck. Bull. Mus. Hist. nat. Paris, pp. 640–646.

—— 1920. Spongiaires du Musée Zoologique de Strasbourg. Bull. Inst. océanogr. Monaco, 381, pp. 1–34, 5 figs.

—— 1921. Sur les Ciocalypta Bow. Ass. franç. avanc. Sci., pp. 687–692.

—— 1925. Étude de Spongiaires du Golfe de Naples. Arch. zool. expér. LXI, pp. 623–725, 1 pl., 27 figs.

—— 1929. *Spongionella* Bow. et *Cacospongia* Schm. Bull. Inst. océanogr. Monaco, 537, pp. 1–12, 3 figs.

—— 1929. Spongiaires de l'Atlantique et de la Mediterranée. Rés. Camp. sci. Monaco, LXXIV, 376 pp., 11 pls.

ULICZA, E. 1929. Die tetraxonen Schwämme Westindiens. Zool. Jahrb. Jena, Suppl. XVI, pp. 36–62, 1 pl., 76 figs.

VOSMAER, G. C. J. 1880. Sponges of the Leyden Museum. I: The Family of the Desmacidinae. Notes Leyden Mus. II, pp. 99–164.

—— 1887. Porifera [in] Bronn: Die Klassen und Ordnungen des Thierreichs, II, pp. 369–496.

VOSMAER, G. C. J. 1911. The Porifera of the "Siboga" Expedition. II: The Genus *Spirastrella.* "Siboga"-Expeditie, VI, A[1], pp. 1–69, 14 pls.

WHITELEGGE, T. 1902. Report on Sponges from the Coastal Beaches of New South Wales. Rec. Aust. Mus. IV, pp. 55–118, 6 pls.

—— 1906. Scientific Results of the Trawling Expedition of H.M.C.S. "Thetis." Part 9: Sponges. Mem. Aust. Mus. IV, pp. 453–484, 2 pls.

—— 1907. Scientific Results of the Trawling Expedition of H.M.C.S. "Thetis." Mem. Aust. Mus. IV, pp. 487–515, 2 pls.

WILSON, H. V. 1925. Siliceous and Horny Sponges collected by the U.S. Fisheries Steamer "Albatross" during the Philippine Expedition, 1907–10. Bull. U.S. Nat. Mus. Washington, 100, 532 pp., 59 pls.

WRIGHT, E. P. 1881. On a New Genus and Species of Sponge with supposed Heteromorphic Zooids. Trans. R. Irish Acad. XXVIIII, pp. 13–20, 1 pl.

INDEX

DESCRIPTION OF PLATE I.

Figs. 1–7.—*Adocia pumila* (Lendenfeld). Figs. 1, 2, 5, natural size ; figs. 3, 4, 6, slightly less than natural size ; fig. 7, $\times \frac{2}{3}$.

Figs. 8, 9.—*Ophlitaspongia eccentrica*, sp. n. Natural size.

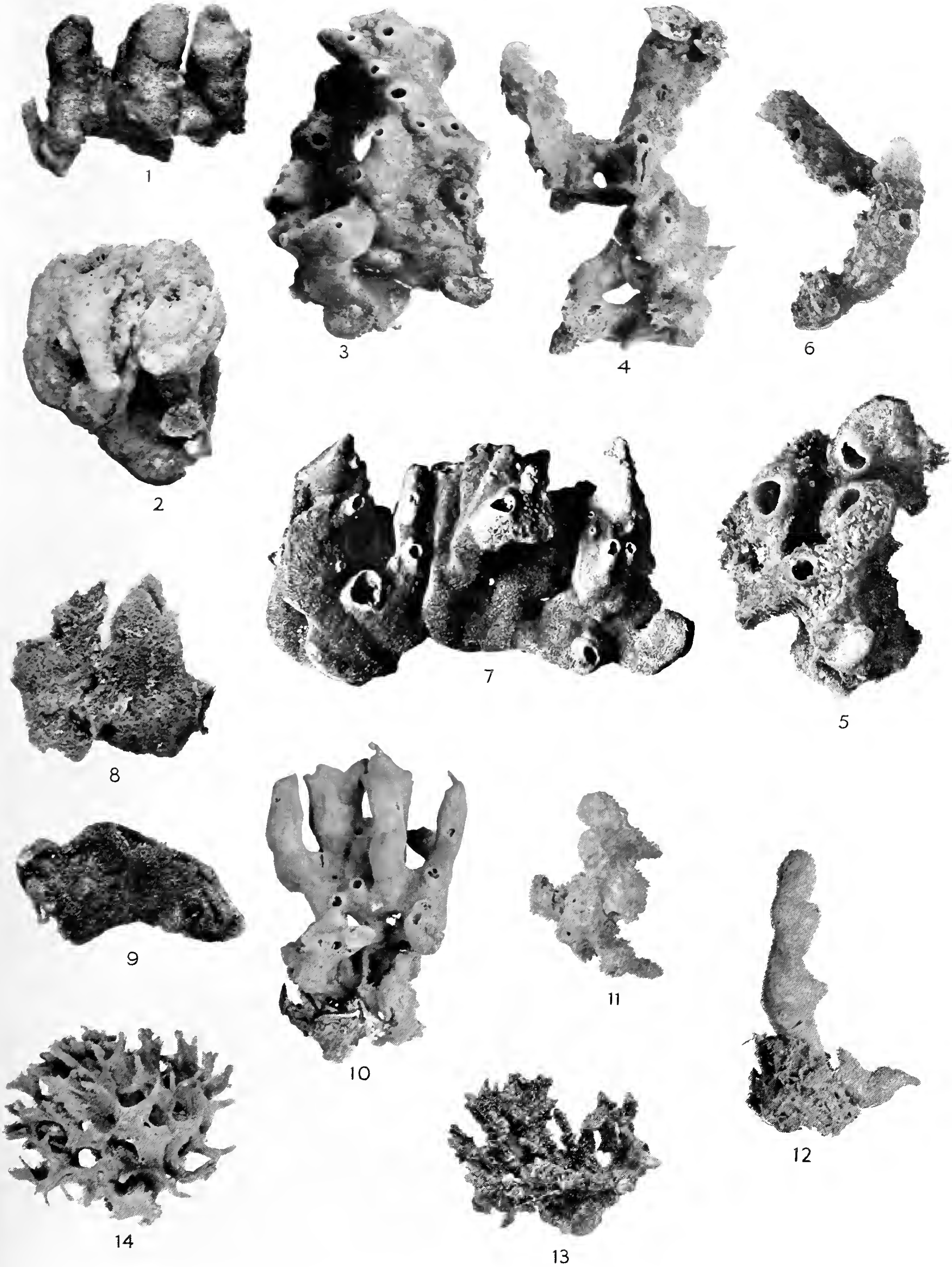
Fig. 10.—*Haliclona flabello-digitata*, sp. n. $\times \frac{2}{3}$.

Fig. 11.—*Hircinia ramosa*, Keller. Natural size.

Fig. 12.—*Hircinia ramodigitata*, sp. n. Natural size.

Fig. 13.—*Echinochalina anomala*, Hallmann. Natural size.

Fig. 14.—*Haliclona reticulata*, Lendenfeld. $\times \frac{2}{3}$.



Adlard & Son, Ltd., Impr.

DESCRIPTION OF PLATE II.

(Figures 3–10 natural size.)

FIG. 1.—*Haliehondria phakellioides*, Dendy and Fredcrick. $\times \frac{1}{2}$.

FIG. 2.—*Spongelia palleseens*, var. *elastiea*, Schulze's specimen (B.M. 83.12.4.26). $\times \frac{3}{5}$.

FIG. 3.—*Spongelia palleseens*, Schmidt, from the Naples Station (B.M. 25.11.1.360).

FIG. 4.—*Spongelia palleseens*, Schmidt, from the Adriatic (B.M. 67.7.26.9).

FIG. 5.—*Dysidea fragilis* (Montagu), from the English Channel (B.M. 25.11.1.1034).

FIG. 6.—*Dysidea fragilis* (Montagu), from Hastings (B.M. 81.5.5.31–3).

FIG. 7.—*Dysidea fragilis* (Montagu), from the "Porcupine" Collection, Stn. 4 (S.W. of Ireland: B.M. 87.7.28.12–15).

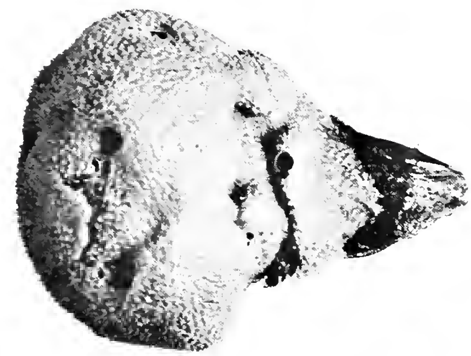
FIG. 8.—*Dysidea fragilis* (Montagu), from Sussex Coast (slightly macerated).

FIG. 9.—*Dysidea fragilis* (Montagu), from Dorset (B.M. 97.8.9.70–1).

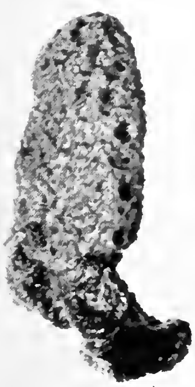
FIG. 10.—*Dysidea fragilis*, (Montagu), from Poole (B.M. 89.7.26.7–12).

FIG. 11.—*Dysidea fragilis* (Montagu), from Norway (B.M. 10.1.1.598).

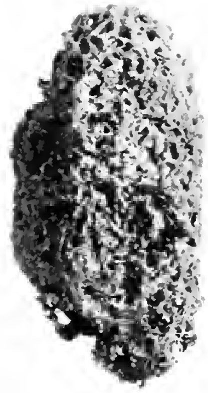
1



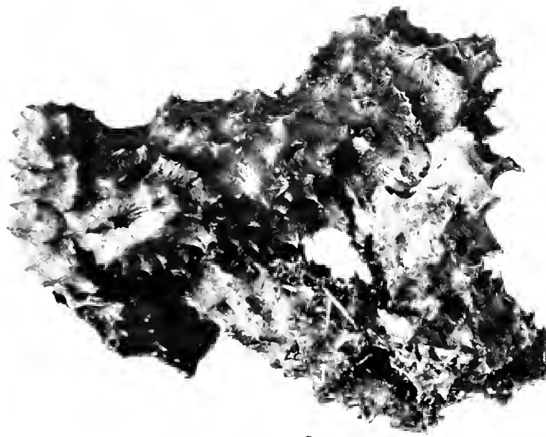
2



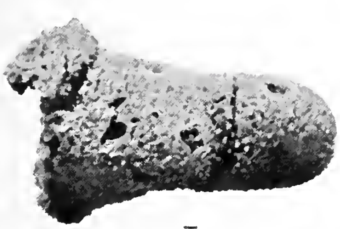
5



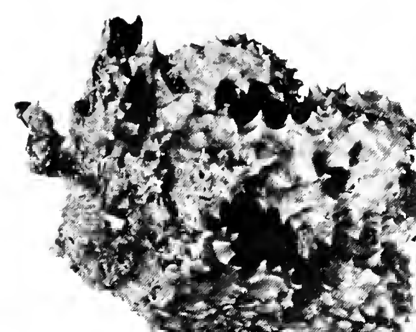
6



3



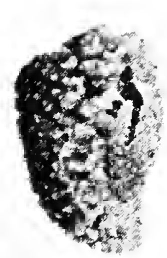
7



4

8

9



10

11

Adlard & Son, Ltd., Impr.

BRITISH MUSEUM (NATURAL HISTORY)

GREAT BARRIER REEF EXPEDITION 1928–29

SCIENTIFIC REPORTS

VOLUME IV, No. 15

THE SILICOFLAGELLATA AND TINTINNOINEA

BY

SHEINA M. MARSHALL, D.Sc.
Naturalist, Marine Station, Millport

WITH FORTY-THREE TEXT-FIGURES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
SOLD BY
B. QUARITCH, LTD., 11 GRAFTON STREET, NEW BOND STREET, LONDON, W.1; DULAU & CO., LTD., 32 OLD BOND STREET, LONDON, W.1; OXFORD UNIVERSITY PRESS, WARWICK SQUARE, LONDON, E.C.4
AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1934

Price Five Shillings

[*Issued 10th September, 1934*]

Made and printed in Great Britain.

THE SILICOFLAGELLATA AND TINTINNOINEA.

BY

SHEINA M. MARSHALL, D.Sc.,

Naturalist, Marine Station, Millport.

WITH FORTY-THREE TEXT-FIGURES.

CONTENTS.

THE SILICOFLAGELLATA.

INTRODUCTION.

SILICOFLAGELLATES are rare in the material of the Great Barrier Reef Expedition. This is to be expected, since their small size enables them to pass through the meshes of even the finest net used, but the numerous water samples centrifuged and examined during the course of the year show that they were actually present only in very small numbers (Marshall, 1933, Vol. II, No. 5). They showed no seasonal variation, but appeared occasionally throughout the year in numbers up to 30 per litre. The specimens figured here are mainly those taken in the international fine silk net (see Russell and Colman, 1931, Vol. II, No. 2, for details of apparatus and position of stations).

Silicoflagellates have long been known from their skeletons, particularly in fossil material, but it is only comparatively recently that much attention has been paid to the protoplasmic body. They were for long considered to belong to the Radiolaria, either as members of the Acanthodesmidae (Haeckel, 1862), or as only parts of the skeleton of Radiolarians (Phaeodarian) (Hertwig, 1879, and Haeckel, 1887). In 1891, however, Borgert, working mainly on *Distephanus speculum*, proved that they were independent organisms. He described the flagellum, and separated them from the Radiolaria, making for them a special group in the Mastigophora. Recently Schulz (1928) and Gemeinhardt (1930) have published monographs on the whole group, and the latter has added considerably to our knowledge of the living form. The observations on living specimens which are given below were made on material from the Clyde sea-area, but, so far as could be ascertained, they are true also of the Great Barrier Reef specimens. Silicoflagellates are very delicate organisms, and do not live for long in the laboratory under any circumstances; conditions on Low Isles were not favourable for their survival.

Anatomy.

The hollow siliceous skeletons of the two living genera *Distephanus* and *Dictyocha* are similar in plan, and can be understood by an examination of Text-fig. 1. There is a basal "ring", four-sided in the case of *Dictyocha* and six-sided in the case of *Distephanus*, from each angle of which a spine projects radially. From about the middle of each side there rises a supporting bar. In *Dictyocha* the bars from adjacent sides unite and are joined by a central arch; in *Distephanus* the bars support a second, apical "ring". Small spines are also present, usually one directed abapically on each of the four or six sides of the basal ring, between the radial spine and the supporting bar to the right of it, and often one or more directed apically on the central arch or apical ring.

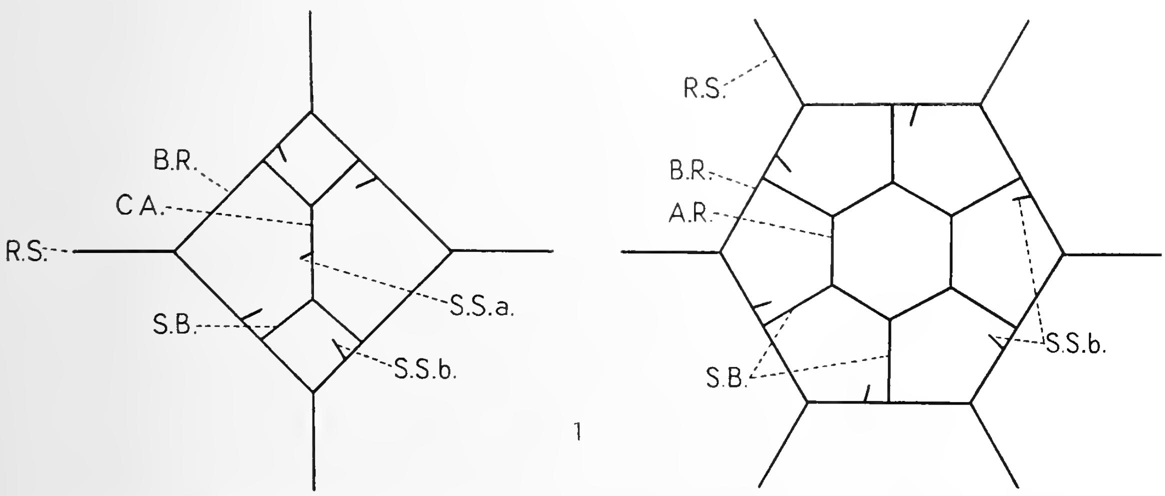
There is a great deal of variation in the form of the skeleton. The radial spines may be long or short, they may be bifid or be absent altogether; one side may be incomplete; in *Dictyocha* the basal ring may be three-, four- or five-sided, and in *Distephanus* four-, five-, six-, seven-, eight- or nine-sided, with all the modifications consequent on this disturbance of the usual arrangement; in *Distephanus* the apical ring may be absent, or it may be divided into two or more. Some of these variations (such as bifid spines or an incomplete side) are obviously mere abnormalities, while some occur so frequently and regularly as to be classed as separate varieties. In several cases the variation seems to take a form transitional between one species and another, or between one genus and another. Schulz and Gemeinhardt have divided the genera *Dictyocha* and *Distephanus* into a small number of species, each with a large number of varieties and forms.

In all the varieties described double specimens occur. These consist of two individuals with their basal rings closely apposed. They hold together firmly and are not easily detached from one another. Borgert considered these to be conjugating forms, but Gemeinhardt has shown that they are really in course of division, and he has described and figured a number of stages in the process. In such pairs the skeleton of one is often much thinner than that of the other. Nuclear division does not take place till the second skeleton is fully formed.

When mounted in canada balsam the hollow interior of the skeleton has a different refractive index from the rest of the skeleton. It looks as if it were filled with air, and

this sometimes makes the examination of the nucleus difficult. Immediately after mounting the skeleton may be quite transparent, but in a short time there is the appearance of a minute bubble in one corner, and this spreads rapidly through the whole cavity of the skeleton. If, however, any part is broken, even the tip of a small spine, this bubble vanishes and the whole skeleton becomes perfectly transparent again. Lemmermann (1901) mentions this difficulty, and says that skeletons, heated on a slide, will fill with air which may be got rid of by means of alcohol, and he suggests that fine pores may be present in the skeleton. The bubble appearance comes, however, even when the specimen has never been allowed to dry. Borgert evaded the difficulty by mounting his specimens in glycerine, by which means he could make it disappear entirely.

An early description of a living Silicoflagellate was that by Johannes Müller in 1855, and it contains the following: "An den frisch beobachteten Exemplaren einer sechsstrahligen *Dictyocha* [now *Distephanus*] war das Kieselnetz von einer gelblichen organischen



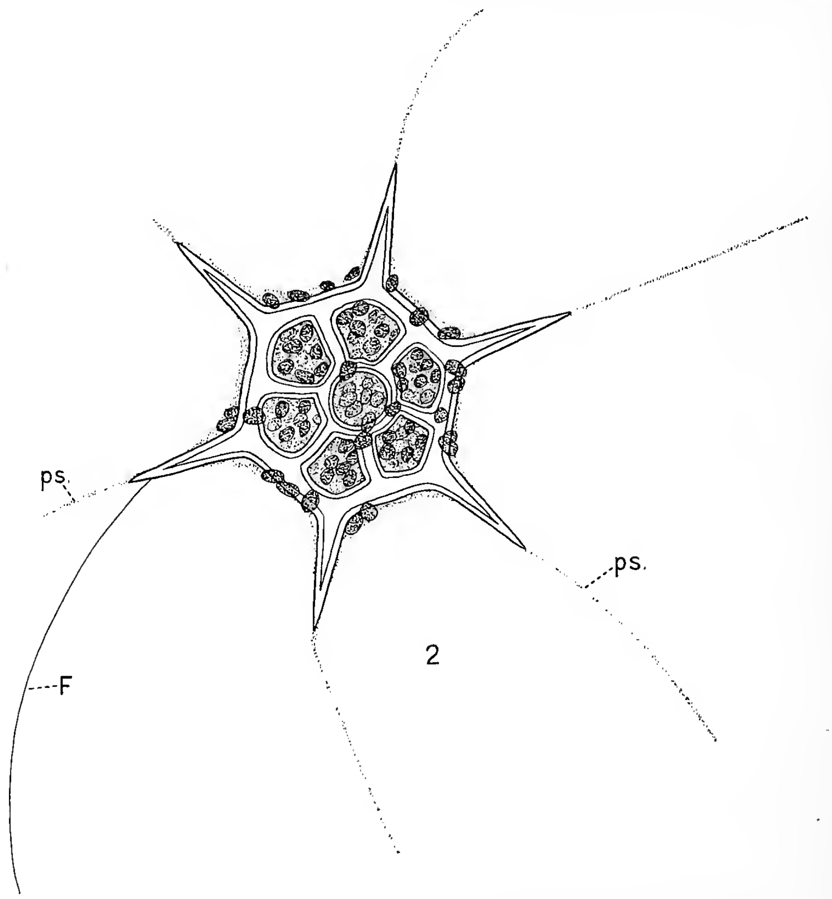
Text-fig. 1.—Diagrams showing the skeletons of *Dictyocha fibula* (left) and *Distephanus speculum* (right), viewed from the apical side. A.R. Apical ring. B.R. Basal ring. C.A. Central arch. R.S. Radial spine. S.B. Supporting bar. ss_a. Small spines directed apically. ss_b. Small spines directed abapically.

Substanz gefüllt, die das Netz auch auswendig überzog und verhüllte und war der Körper niemals in weiche Strahlen verlängert." This observation of his on the enveloping layer of protoplasm was unconfirmed, and indeed denied by subsequent workers until recently, but it is perfectly correct. Gemeinhardt describes and figures this "exoplasma" in *Distephanus speculum*, and it is even more clearly seen in *Dictyocha fibula*.

The cell body of a *Distephanus speculum* is of clear hyaline protoplasm. As a rule it extends beyond the skeleton, forming a delicate covering over it and reaching to the tips of the spines. There it is drawn out into exceedingly fine threads or pseudopodia (Text-fig. 2). These are mobile, and are very variable, being sometimes visible on every spine, sometimes only on one or two.* In an unhealthy specimen, or in one which has been long under the coverslip, they are not to be seen at all. Occasionally two threads are visible from the tip of one spine. When in motion they swing slowly backwards and forwards, and can

* I have found similar delicate pseudopodia extending beyond the tips of the spines in living Radiolaria (Acantharia).

probably alter their form also by amœboid movement. They vary greatly in length, and may be as long as 50μ. These pseudopodia resemble the flagellum very much in appearance, except that they are usually finer and do not move in the same way. The flagellum, as a rule, comes out close to the base of a spine, and extends beyond it for a short distance. Sometimes only the tip is in active motion, sometimes the whole flagellum is thrown into waves. In a healthy living specimen the small yellowish-brown chromatophores are embedded in the protoplasm, not only within the space enclosed by the skeleton, but also outside it. They tend to collect round the bases of the spines, and give the animal a typical

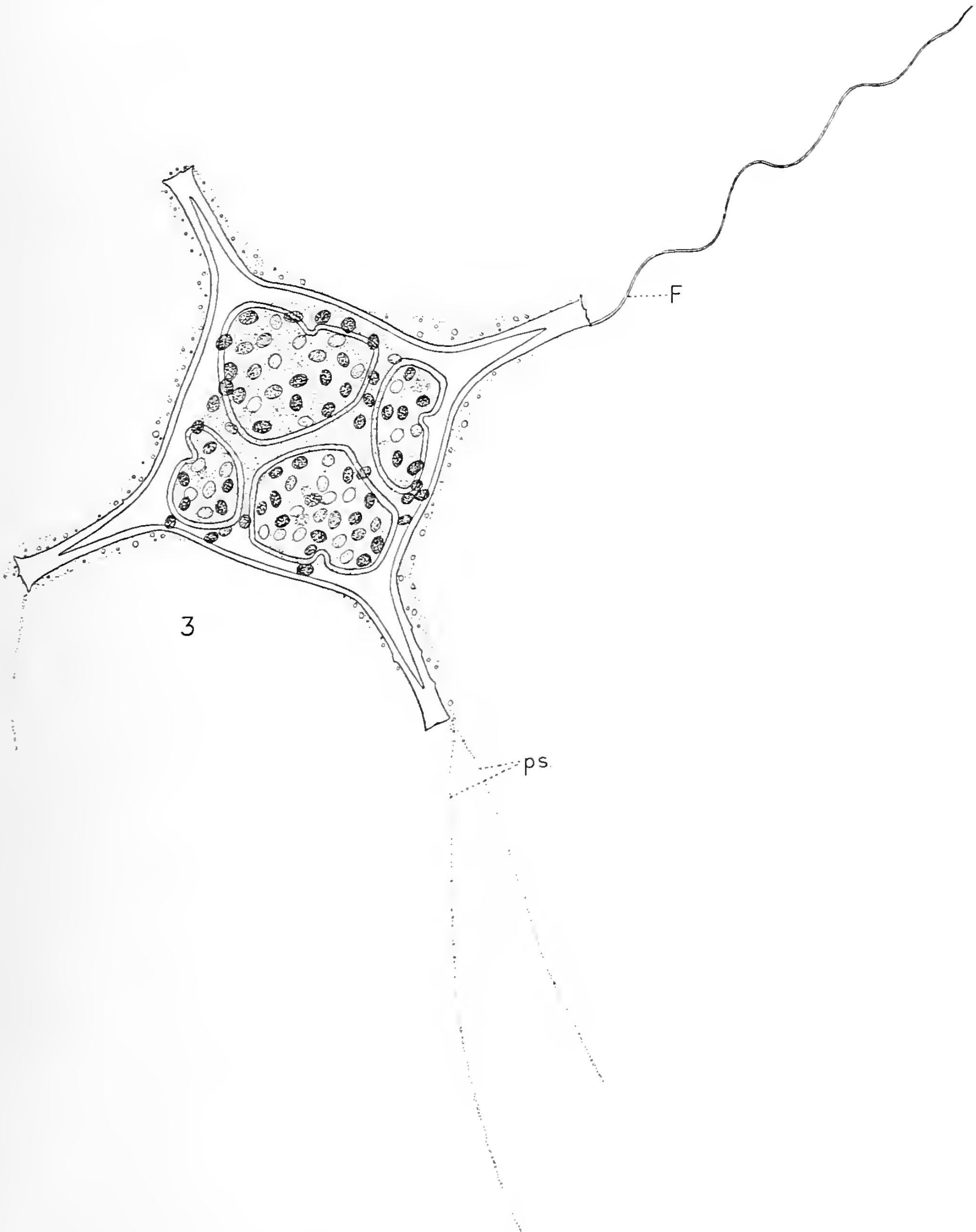


TEXT-FIG. 2.—Living specimen of *Distephanus speculum,* showing pseudopodia (*ps.*) and flagellum (F.). From the Firth of Clyde.

rosette-like appearance. In many specimens, particularly those which have been long under observation, the chromatophores are contracted into a central mass within the skeleton. The flagellum may be visible even after this has taken place. The nucleus, which is not visible in the living cell, has been described by Gemeinhardt as spherical, containing one, or occasionally two, nucleoli. Borgert describes the nucleus as oval. He states that there is an intensely staining, round, chromatin body surrounded by a lightly staining layer, which is separated by a thin membrane from the cytoplasm. My observations agree with Borgert's, except that the nucleus is usually rounded, but may be rather irregular in shape.

In *Dictyocha fibula* (Text-fig. 3) the protoplasmic body is very similar to that of *Distephanus.* It shows the same enveloping layer, which in this case is much more obvious

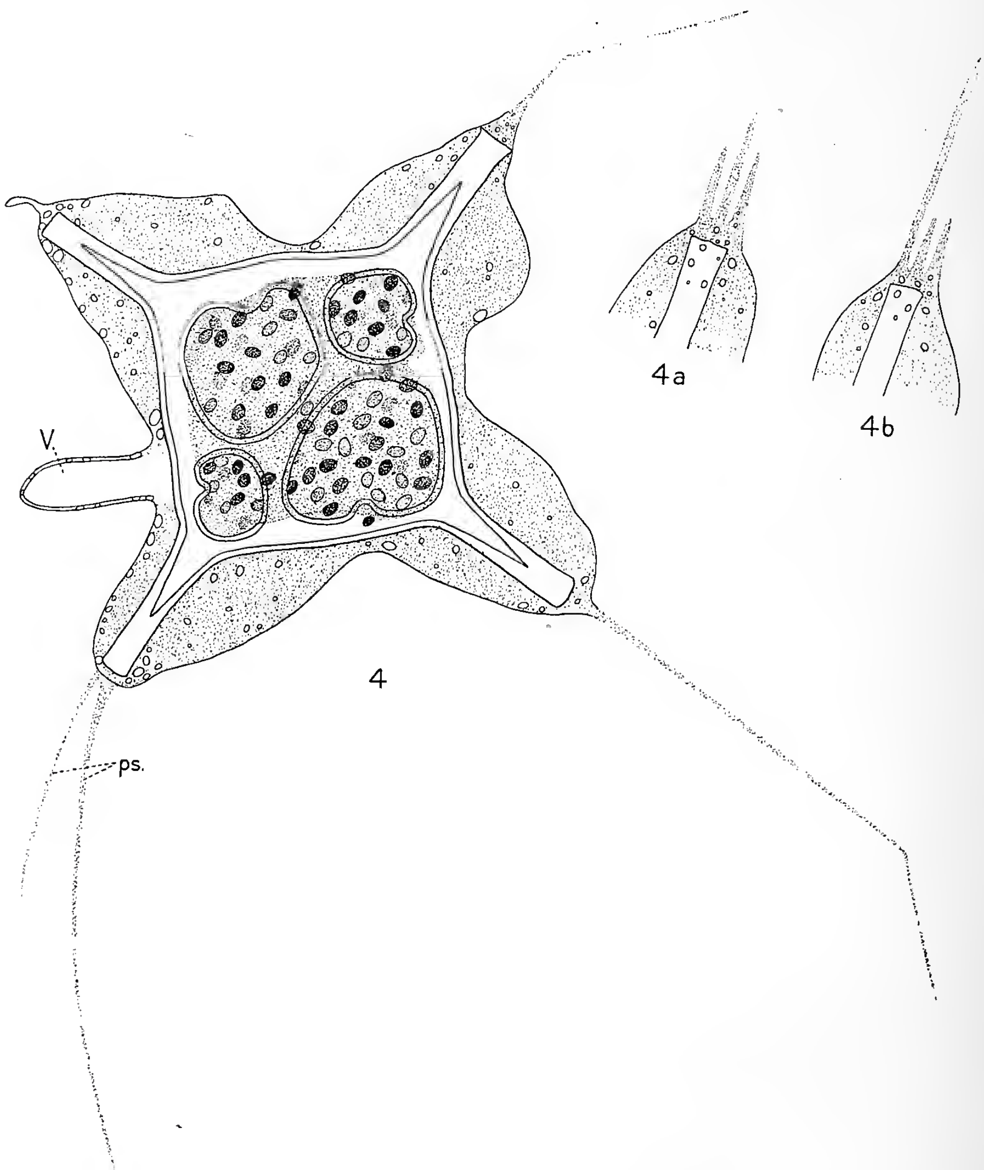
because it is filled with minute refractive granules, and is often more extensive. The fine pseudopodia are also seen, and these, besides showing backward and forward movements, may change their shape rapidly by amoeboid movements. A flagellum is not often seen



TEXT-FIG. 3.—Living specimen of *Dictyocha fibula* viewed from the abapical side showing pseudopodia (*ps.*) and flagellum (F.). From the Firth of Clyde.

but, when present, is similar to that found in *Distephanus*. Chromatophores similar to those in *Distephanus* are present and show the same arrangement. In one specimen observed (Text-fig. 4) the cytoplasm outside the skeleton was much more extensive than usual and showed a definite external layer, which is not commonly seen. It formed broad lobes round the spines, from the tips of which extended very mobile pseudopodia (see

Text-figs. 4, 4*a*, 4*b*, which represent the same spine at short intervals of time). From about the middle of one side projected a long oval vacuole with a thin wall, and this remained constant in form and position for a considerable time, and even after fixation. The chromatophores were mostly massed in the centre, but the condition of the pseudopodia

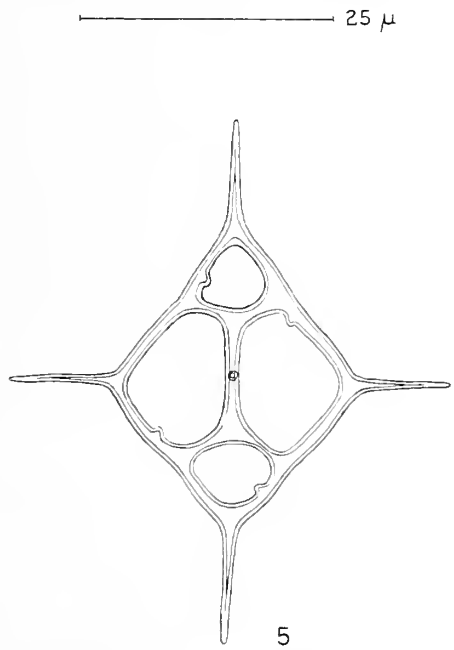


TEXT-FIG. 4.—Living specimen of *Dictyocha fibula* viewed from the abapical side, showing a large amount of protoplasm and a vacuole (*v.*). 4*a* and 4*b* show further alterations in the pseudopodia effected by amoeboid movement. From the Firth of Clyde.

shows that this was a healthy specimen. Gemeinhardt states that before division the amount of protoplasm in *Distephanus* is increased, and it seems possible that this *Dictyocha* was about to divide, and that the vacuole indicated where a future spine would be laid down. If this were so, the resulting skeleton would be abnormal; but dividing forms are frequently seen, in which one member of the pair is normal and the other abnormal. The nucleus in *Dictyocha* is similar to that in *Distephanus*. It is more frequently irregular

in shape, however, and there are often small masses of darkly staining material along the membrane separating it from the cytoplasm. A more deeply staining nucleolus can sometimes be made out in the central mass.

I am indebted to Miss Brown Kelly for the drawings of Silicoflagellates.



TEXT-FIG. 5.—*Dictyocha fibula* var. *stapedia*. From the Great Barrier Reef region.

DESCRIPTIONS OF SPECIES.

Dictyocha fibula var. *stapedia* (Haeckel), Lemmermann. Text-fig. 5.

Gemeinhardt, 1930, p. 53, fig. 42.

OCCURRENCE.—Found occasionally throughout the year, but only in small numbers. The highest numbers were obtained on 26th January near Low Isles (3 in 100 c.c.). Within the Great Barrier Reef they were distributed more or less evenly from the surface down to 28 metres (the greatest depth sampled), and at stations outside it the few specimens present were not taken below 20 metres.

DISTRIBUTION.—The Atlantic, Indian and Pacific Oceans.

REMARKS.—In this variety the basal ring is a rhomboid, and one pair of spines is slightly longer then the other. The central arch lies parallel to the longer axis.

DIMENSIONS.—Total length as measured from spine tip to spine tip on the longer axis 39–52μ ; length of side 18–24μ ; length of spines 8–11μ and 7–9μ.

Dictyocha fibula var. *hexagona*, n. var. Text-fig. 6.

Gemeinhardt, 1931, p. 233, pl. xlii, fig. 15.

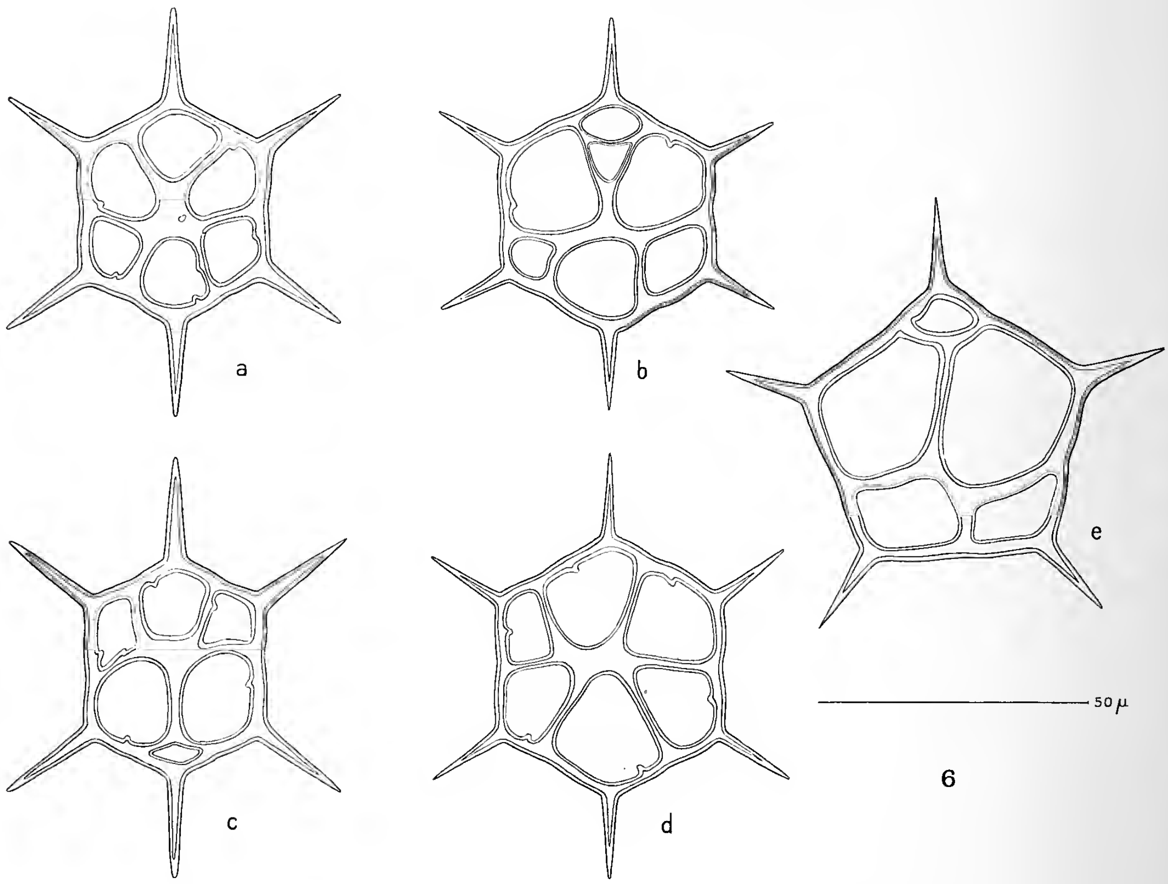
OCCURRENCE.—Appeared only rarely throughout the year.

DISTRIBUTION.—The Great Barrier Reef region.

DESCRIPTION.—This variety possesses no apical ring, and appears to be in some respects transitional between *Dictyocha* and *Distephanus*. It has a six-sided basal ring.

The supporting bars from adjacent sides fuse and the three resulting bars unite to form a roughly triangular area. Text-fig. 6*a* shows the usual form but there is a good deal of variation, and Text-figs. 6*b–e* show several specimens. Small spines are present on the basal ring in the usual position, and are not infrequent on the supporting bars. The five-sided form (Text-fig. 6*e*) was seen only twice.

REMARKS.—This is a difficult form to place. Since it possesses no apical ring it must belong to the genus *Dictyocha*, but it has obvious affinities to *Distephanus speculum* forma *pseudo-fibula*, Schulz. Gemeinhardt (1931) found a single specimen in the material of the



TEXT-FIG. 6.—*Dictyocha fibula* var. *hexagona*, n. var., showing variations in the skeleton. From the Great Barrier Reef region.

German South Polar Expedition, and figured it as an abnormal *Distephanus speculum*, suggesting, however, that it might be a transitional form between *Mesocena polymorpha* var. *hexagona* and *Dictyocha*. Since it appears with fair regularity in the Great Barrier Reef material, it may be classed as an independent variety. A six-sided *Dictyocha*, *D. hexacantha*, Schulz, is already known (as a fossil only), but differs from this in having only three supporting bars, rising opposite the bases of alternate radial spines.

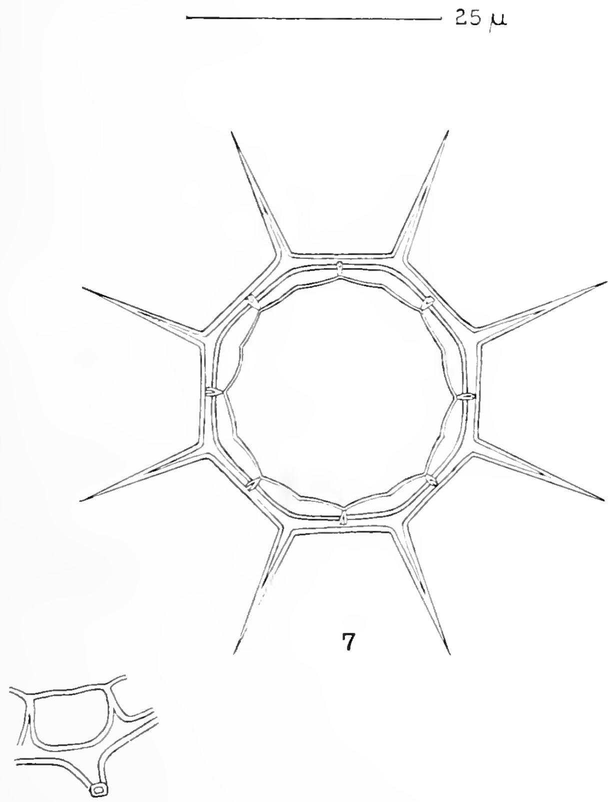
The five-sided form (Text-fig. 6*e*) corresponds to *Dictyocha fibula* var. *pentagona*.

DIMENSIONS.—Diameter of basal ring 39–47μ ; diameter from spine-tip to spine-tip, 72–86μ ; length of one side 24–26μ ; length of radial spines 13–17μ.

Distephanus speculum var. *bioctonarius* (Ehrenberg). Text-fig. 7.

Mesocena polymorpha var. *bioctonaria*, Gemeinhardt, 1930, p. 32, fig. 17.
Distephanus speculum var. *octonarius*, Gemeinhardt, 1930, p. 69, figs. 59*b*, 60.

Occurrence.—Appeared occasionally throughout the year in small numbers. In water samples they were never more abundant than one in 100 c.c. The station at which most were obtained was H 28 on 19th November, outside Trinity Opening, where they were not taken deeper than 50 m.



7a

Text-fig. 7.—*Distephanus speculum* var. *bioctonarius*. 7*a*. Detail of skeleton. From the Great Barrier Reef region.

Distribution.—The North Sea, the Atlantic, Pacific and Antarctic Oceans ; widely distributed as a fossil.

Remarks.—The distinguishing feature of this variety, apart from its octagonal form, is the extreme delicacy of the apical ring. This has a diameter almost as great as that of the basal ring, and is solid, not hollow like the rest of the skeleton. The cavity extends only about half-way up the supporting bars (Text-fig. 7*a*). The apical ring does not always form a double arch between each pair of bars as is shown in Text-fig. 7. The radial spines are square in cross-section (Text-fig. 7*a*). Small spines were occasionally present on the apical ring, but none were observed on the basal ring. One specimen was seen with nine-sided basal and apical rings.

This variety was first found as a fossil (Ehrenberg, 1845, p. 78), and, since it lacked the apical ring either partly or wholly, was described as *Mesocena bioctonaria*. The form

possessing both basal and apical rings was put by Gemeinhardt in *Distephanus speculum* var. *octonarius* (Ehrenberg), Jörgensen. This variety *octonarius* does not, however, differ at all from the typical form except in having eight sides, and it seems to me better to keep Ehrenberg's name for the forms with a solid, delicate, apical ring. The number of sides is an exceedingly variable character throughout the family, and individual abnormalities seem to be frequent; forms with a solid apical ring, on the other hand, have not been described except in *Distephanus speculum.* They may occur with seven (Gemeinhardt, 1930), eight or nine sides. The variety is well marked and occurs regularly in the plankton (Gemeinhardt, 1931, Schulz, 1928, and present records).

Dimensions.—Diameter of basal ring 28–30μ; diameter of apical ring about 23μ; length of radial spines varying from one specimen to another, 4–13μ.

THE TINTINNOINEA.

Introduction.

The Tintinnids described below are those captured in tow-nettings taken with the International fine silk net described by Russell and Colman (1931, Vol. II, No. 2). The majority of the catches were taken at the weekly station, but two were from stations in the main channel further to the north (Cape Bedford and Lizard Island), and three in passages through the outer barrier (Trinity Opening and Papuan Pass). For the positions of these stations reference should be made to the charts in Vol. II, No. 1 (Russell and Orr, 1931). Work was carried on from July, 1928, till July, 1929, and the results therefore apply to a complete year.

Kofoid and Campbell have recently published (1929) a conspectus of the order Tintinnoinea, in which they review the entire group and the literature concerning it. I am greatly indebted to this work and have throughout followed their classification, which is based entirely on the lorica. Recent work by Hofker (1931) indicates that a study of the lorica alone is not sufficient for a final classification, since there is much variation in shape and structure, and that a number of Kofoid and Campbell's species are in reality only variant forms. At present, however, the lorica is in many cases the only part of the animal available for identification, and descriptions must be based on it.

Fifty-six species occur, of which three are new.

I am greatly indebted to Miss Brown Kelly for the drawings which illustrate this report, with the exception of Text-figs. 8–11.

List of Species.

Tintinnididae.
- **Leprotintinnus nordqvisti* (Brandt).

Codonellidae.
- *Tintinnopsis compressa,* Daday.
- **T. mortensenii,* Schmidt.
- †*T. rotundata,* Jörgensen.
- ‡*T. gracilis,* Kofoid and Campbell.
- *T. radix* (Imhof).
- *T. cylindrica,* Daday.
- †*T. tocantinensis,* Kofoid and Campbell.

Codonellopsidae.
- *Stenosemella nivalis* (Meunier), Kofoid and Campbell.
- **Codonellopsis ostenfeldii* (Schmidt).
- **C. indica,* Kofoid and Campbell.
- §*C. parvicollis,* n. sp.
- ‡*C. brevicaudata,* Brandt.

Coxliellidae.
- *Climacocylis scalaria* (Brandt), Jörgensen.
- ‖*C. scalaroides,* Kofoid and Campbell.
- **Coxliella laciniosa* (Brandt).

Cyttarocylidae.
**Favella azorica* (Cleve), Jörgensen.

Ptychocylidae.
‡*Epiplocylis ralumensis* (Brandt).
‖*E. healdi*, Kofoid and Campbell.
‡*E. constricta*, Kofoid and Campbell.
‖*E. exigua*, Kofoid and Campbell.
E. blanda (Jörgensen), Kofoid and Campbell.
E. undella (Ostenfeld and Schmidt).
‡*E. deflexa*, Kofoid and Campbell.

Petalotrichidae.
§*Craterella aperta*, n. sp.
‖*Metacylis corbula*, Kofoid and Campbell.

Rhabdonellidae.
Protorhabdonella simplex (Cleve), Jörgensen.
P. curta (Cleve), Jörgensen.
Rhabdonella spiralis (Fol), Brandt.
R. brandti, Kofoid and Campbell.
‖*R. quantula*, Kofoid and Campbell.
R. amor (Cleve), Brandt.
‖*Rhabdonellopsis intermedia*, Kofoid and Campbell.

Xystonellidae.
Xystonella lanceolata (Brandt), Brandt.
X. treforti (Daday), Laackmann.

Undellidae.
**Undella hemispherica*, Laackmann.
‖*U. turgida*, Kofoid and Campbell.
**Proplectella tenuis*, Kofoid and Campbell.
‖*P. perpusilla*, Kofoid and Campbell.
†*P. acuta* (Jörgensen).

Dictyocystidae.
Dictyocysta reticulata, Kofoid and Campbell.

Tintinnidae.
Amphorella quadrilineata (Claparède and Lachmann), Daday.
A. brandti, Jörgensen.
†*A. laackmanni* Jörgensen.
†*A. minor*, Jörgensen.
Steenstrupiella steenstrupii (Claparède and Lachmann).
†*S. intumescens*, Jörgensen.
**Amphorellopsis acuta* (Schmidt).
Dadayiella ganymedes (Entz Sr.), Kofoid and Campbell.
Tintinnus attenuatus, Kofoid and Campbell.
T. lusus-undae, Entz Sr.
‖*T. stramentus*, Kofoid and Campbell.
‖*T. pacificus*, Kofoid and Campbell.
T. apertus, Kofoid and Campbell.
§*Daturella luanae*, n. sp.
‖*Salpingella subconica*, Kofoid and Campbell.

Distribution.

Among the Tintinnids obtained by the Expedition two groups can be distinguished: firstly, those adapted to neritic conditions, and secondly, those which are oceanic in habitat and are restricted to water of relatively high salinity. Members of the first group are found throughout the year and are often especially common in March. They include most species of the genera *Leprotintinnus*, *Tintinnopsis* and *Codonellopsis*, and *Epiplocylis healdi*, *Rhabdonella spiralis*, *R. brandti* and *R. amor*. Members of the second group are rarer, and occur mainly at the weekly station in August and September (when the salinity inside the Barrier was over $35°/_{00}$), and at stations on or near the outer reefs. Such species are *Climacocylis scalaria*, *Epiplocylis* spp. (apart from *E. healdi*), *Rhabdonella quantula*, *Rhabdonellopsis intermedia*, *Xystonella* spp., *Undella* spp., and *Daturella luanae*. The remainder are either too rare to give an accurate indication of their habitat, or do not conform strictly to either group, although a number were more common at outside stations (*e.g. Proplectella* spp. and *Climacocylis scalaroides*).

Of the fifty-six species listed, twenty-two (unmarked in the above list) are cosmopolitan and have been recorded from the Atlantic, Pacific and Indian Oceans, sometimes from temperate and even arctic regions. Nine species (marked with *), are restricted to warm seas, although they may be widely distributed within the tropics. Of the numerous new species found by Kofoid and Campbell from the Agassiz Expedition to the eastern tropical Pacific, eleven (marked with ‖) can now be recorded from the western Pacific also. Five (marked with ‡) have hitherto been recorded by Brandt from the western Pacific (of which two have also been found by Kofoid and Campbell in the eastern Pacific).

The records of six species (marked with †) are so scattered that their distribution cannot be ascertained at all accurately. The remaining three species (marked with §) are new.

Table I shows the occurrence of the species throughout the year at the stations examined, and for this records from water samples have been used, where available, as well as those from tow-nettings. It will be seen that catches from outside stations are usually rich in species, although they lack the neritic forms. One of the richest catches (for numbers of species) was that from Lizard Island on 27th February. This is partly because, being near the outer reefs, oceanic as well as neritic species are represented, and partly because diatoms were abundant. These tend to block the meshes of the net, so that small species which would otherwise be lost are retained. The richest catch of all (containing forty-three species) was obtained, however, at the weekly station on 4th March. Twenty-one out of the fifty-six species are present throughout the year, and may be considered as characteristic of the fauna of the Great Barrier Reef lagoon.

The results from stations on or near the outer reefs suggest that there is a rich tintinnid fauna in the ocean waters outside, of which only some species can live permanently within the Barrier.

In the following descriptions reference is made only to the earliest description of the species and to Kofoid and Campbell's monograph, where a full list of synonyms will be found.

Descriptions of Species.

Leprotintinnus nordqvisti (Brandt).

Tintinnopsis nordqvisti, Brandt, 1906, pp. 4, 18 ; pl. xxiv, figs. 1–4 ; 1907, pp. 166–167.
Leprotintinnus nordqvisti, Kofoid and Campbell, 1929, p. 17, fig. 13.

Occurrence.—This species was present throughout the year and was abundant in November and March. It was not taken outside the Great Barrier Reef.

Distribution.—The N. coast of South America and the mouth of the Amazon; Siam, Malay Archipelago, and west coast of Borneo.

Remarks.—The lorica decreases slightly in width towards the aboral end and then flares out to the aboral opening, which is wider (58–123μ) than in the specimens described hitherto (mouth of the Amazon 50–60μ ; coast of Borneo 40–52μ). There is sometimes an indication of a spiral structure in the arrangement of agglomerated material on the tube, but this is never clear.

Dimensions.—Length 125–254μ ; diameter at mouth 34–44μ ; diameter at aboral end 58–123μ ; diameter just above aboral flare 30–34μ.

Tintinnopsis compressa, Daday. Text-fig. 8.

Tintinnopsis beroidea var. *compressa*, Daday, 1887, p. 548, pl. xix, figs. 7–9, 28. *T. nucula*, Daday, *ibid.*, p. 554, pl. xix, figs. 30, 31.
Tintinnopsis compressa, Kofoid and Campbell, 1929, p. 32, fig. 71.

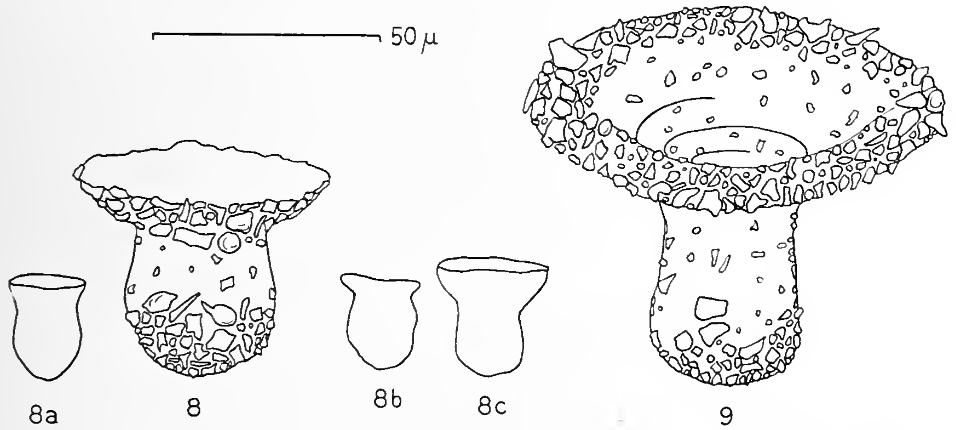
Occurrence.—Occasional throughout the year and common in March.

Distribution.—The Mediterranean ; the Red Sea ; Woods Hole, Massachusetts.

Remarks.—Kofoid and Campbell have united Daday's *T. beroidea* var. *compressa* and his *T. nucula* to form this species, which has also been described from the Mediterranean by Jörgensen (1924).

The present specimens are variable in form. Some of them agree well with the figures of Daday and Jörgensen, but the majority have a more marked suboral constriction and a more spreading brim. Text-fig. 8 shows what is perhaps the most common form. Text-figs. *8a*, *8b*, *8c* are sketches (on a smaller scale) of other varieties, of which *8a* resembles Daday's form most closely.

Dimensions.—Length 39–59μ ; diameter at mouth 34–65μ ; greatest diameter of bowl 28–34μ.



Text-figs. 8, 9.—8, *8a*, *8b*, *8c*. *Tintinnopsis compressa*. 9. *T. mortensenii*.

Tintinnopsis mortensenii, Schmidt. Text-fig. 9.

Tintinnopsis mortensenii, Schmidt, 1902, p. 186, fig. 3 ; Kofoid and Campbell, 1929, p. 40, fig. 61.

Occurrence.—Common in November and March, otherwise occasional.

Distribution.—The Gulf of Siam ; the mouth of the Tocantins.

Remarks.—The marked feature of this species is the wide spreading brim. In the specimens from Siam (Schmidt) the diameter of the brim was 53μ, in those from the mouth of the Tocantins (Brandt, 1907, p. 152) 85μ, and in those from the Great Barrier Reef material it varies from 67 to 108μ. In length the Great Barrier Reef specimens are intermediate between those of Brandt and Schmidt. The species also resembles *T. bütschli* Daday, but is considerably smaller, and has a wider brim in proportion to the length. The agglomerated material is thinly scattered on the proximal part of the brim, but is very thick at the edge. A spiral structure can usually be made out in the throat.

Dimensions.—Total length 60–70μ ; greatest width of bowl 29–38μ ; width of brim 67–108μ.

Tintinnopsis rotundata, Jörgensen.

Tintinnopsis beroidea, Daday, 1887, p. 547, pl. xix, figs. 2, 14.
Tintinnopsis rotundata, Kofoid and Campbell, 1929, p. 46, fig. 73.

Occurrence.—Present during most of the year and common in March.

Distribution.—At Wismer in the Baltic ; the Gulf of Naples.

Remarks.—This is a very regular form and varies little in dimensions. It also resembles closely *T. tenuis* Hada, 1932, from which it differs only in the lack of spiral marking.

Dimensions.—Length 52–57μ ; width 26–28μ.

Tintinnopsis gracilis, Kofoid and Campbell.

Tintinnopsis karajacensis var. a, Brandt, 1906, p. 16, pl. xix, figs. 1, 2, 21 ; 1907, p. 163.
Tintinnopsis gracilis, Kofoid and Campbell, 1929, p. 36, fig. 37.

Occurrence.—Present throughout the year and was abundant in November and March.

Distribution.—The west coast of Borneo.

Remarks.—This form agrees exactly with that figured by Brandt (1906, pl. xix, fig. 2). It is almost cylindrical, widening slightly from the mouth to the lower third and then narrowing to a bluntly conical point.

Dimensions.—Length 123–177μ ; diameter at mouth 34–38μ ; greatest diameter 38–44μ.

Tintinnopsis radix (Imhof). Text-fig. 10.

Codonella radix, Imhof, 1886, p. 103.
Tintinnopsis radix, Kofoid and Campbell, 1929, p. 45, fig. 93.

Occurrence.—Present throughout the year at the weekly station and sometimes abundant (November, March).

Distribution.—A neritic species with a wide distribution along the coasts of the Mediterranean and the Atlantic, Indian and Pacific Oceans.

Remarks.—This species is certainly the *T. fracta* of Brandt (1906, p. 4, pl. xxiii, figs. 1, 3–5, 9–13 ; pl. xxxi, fig. 8 ; 1907, pp. 174–176). He separated it from similar forms (notably *T. curvicauda*, Daday) on account of the opening at the posterior end, which is now generally considered to be an artefact, possibly caused by fixation (Jörgensen, 1924). The opening is always in the same position, on one side of the pedicel ; it extends to the foot and often has a very regular edge ; moreover Brandt says that it was present in every tropical specimen he examined, and this is also true of the Great Barrier Reef material. It is possible that the animal is attached at this point, and that it tears a hole there in leaving its case, or at death by fixation. Further observations on living material are needed to clear up this point, and until this is done it is perhaps better to unite forms which are alike (as Kofoid and Campbell have done), whether they are open at the tip or not. The present material was fixed in formalin, so the break is not caused, as Jörgensen suggests, by alcohol fixation only.

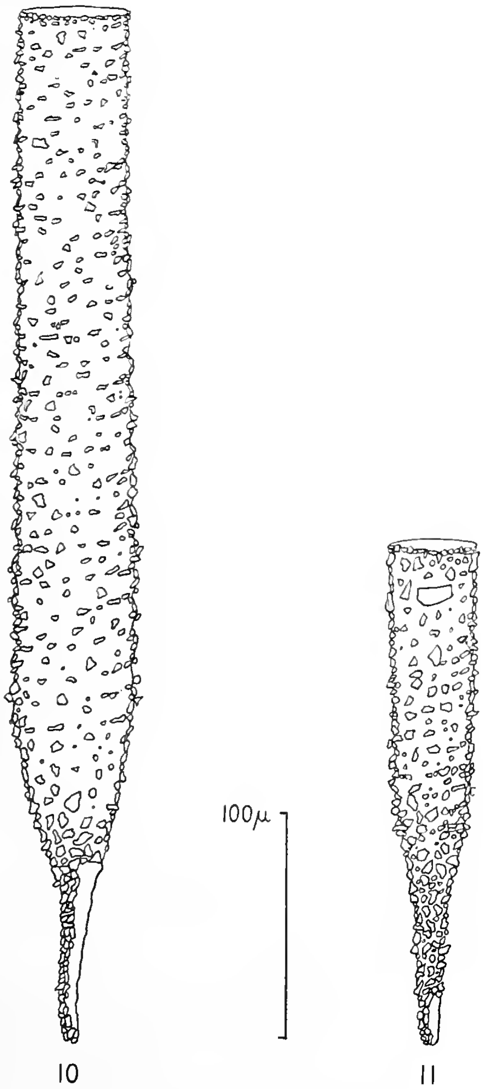
The length, if we consider those from other localities also, is very variable, and in this case (unlike the Tintinnidae) the oral diameter is variable as well. The sizes of the present specimens agree most closely with those of Brandt from the west coast of Borneo (1907, p. 175). The lorica is almost cylindrical for about two-thirds of its length ; it often gets slightly wider towards the bowl, and rarely slightly narrower. In the basal third it narrows to a slender and slightly curved pedicel. A spiral structure is clearly visible from the mouth down to the narrowing. The pedicel and the part close to the mouth are thickly covered with agglomerated particles, but on the rest of the lorica they are scarcer.

Dimensions.—Length 353–502μ ; diameter at mouth 46–61μ ; length of pedicel (measured from where lorica begins to narrow) 116–172μ ; 24–30 spiral turns on the cylindrical part of bowl.

Tintinnopsis cylindrica, Daday. Text-fig. 11.

Tintinnopsis Davidoffi var. *cylindrica*, Daday, 1887, partim, p. 553, pl. xix, fig. 24.
Tintinnopsis cylindrica, Kofoid and Campbell, 1929, p. 33, fig. 96.

Occurrence.—Present throughout the year at the weekly station and sometimes abundant (November and March).



Text-figs. 10, 11.—10. *Tintinnopsis radix*. 11. *T. cylindrica*.

Distribution.—The Mediterranean, the Baltic, the western Pacific.

Remarks.—In two respects this form differs from the type. It often shows a rather indistinct spiral marking, and the tip of the pedicel is open. In this and other respects it resembles *T. radix*. It is smaller than the Great Barrier Reef *T. radix* (although a few specimens of intermediate size are found), but is about the same size as *T. radix* from other localities (*e.g.* Brandt's *T. fracta* from New Pomerania, Zanzibar and S.W. Africa). The pedicel is wider and usually nearly half as long as the whole lorica ; it is very frequently broken off short ; the diameter is less and the lorica invariably gets slightly narrower

towards the pedicel; it is more thickly encrusted with agglomerated material; a spiral structure is often visible, especially towards the pedicel, but it is much less distinct than in *T. radix*. Hada's *T. kofoidi* (1932*a*) resembles this form, but lacks the spiral marking and has straighter sides.

DIMENSIONS.—Length 144–300μ; diameter at mouth 34–45μ (one specimen 50μ); length of pedicel 62–120μ; 8–13 spiral turns on bowl.

Tintinnopsis tocantinensis, Kofoid and Campbell.

Tintinnopsis aperta var. a, Brandt, 1906, p. 19, pl. xxv, figs. 2, 7; 1907, p. 177.
Tintinnopsis tocantinensis, Kofoid and Campbell, 1929, p. 48, fig. 46.

OCCURRENCE.—Very rare. It appeared at a few of the weekly stations in March and April, and off Lizard Island in February.

DISTRIBUTION.—Off the mouth of the Tocantins River, and in Mutsu Bay, Japan.

REMARKS.—This form agrees very closely with Brandt's figure and, like his, is open at the aboral end. In one specimen there was a faint suggestion of spiral marking just below the mouth.

DIMENSIONS.—Length 65–92μ; diameter at mouth 17–19μ; greatest diameter of bowl 22–28μ.

Stenosemella nivalis (Meunier), Kofoid and Campbell.

Codonella ventricosa, Entz Sr., 1884, p. 413, pl. xxiv, fig. 24.
Stenosemella nivalis, Kofoid and Campbell, 1929, p. 69, fig. 136.

OCCURRENCE.—Very rare. In February off Lizard Island, and in October and March at the weekly station.

DISTRIBUTION.—The Mediterranean and the coast of Europe generally; Mutsu Bay, in Japan.

REMARKS.—This is a very small form and seems to vary considerably in shape. The collar contracts a little towards the mouth and is often scarcely emergent. The lorica is usually widest shortly below the collar, and has a broadly rounded aboral end. A good figure is given by Hada, 1932, Text-fig. 11.

DIMENSIONS.—Total length 31–34μ; diameter at mouth 16–19μ; greatest diameter 30μ; height of collar up to 6μ.

Codonellopsis ostenfeldii (Schmidt).

Codonella ostenfeldii, Schmidt, 1902, p. 187, fig. 4.
Codonellopsis ostenfeldi, Kofoid and Campbell, 1929, p. 84, fig. 160.

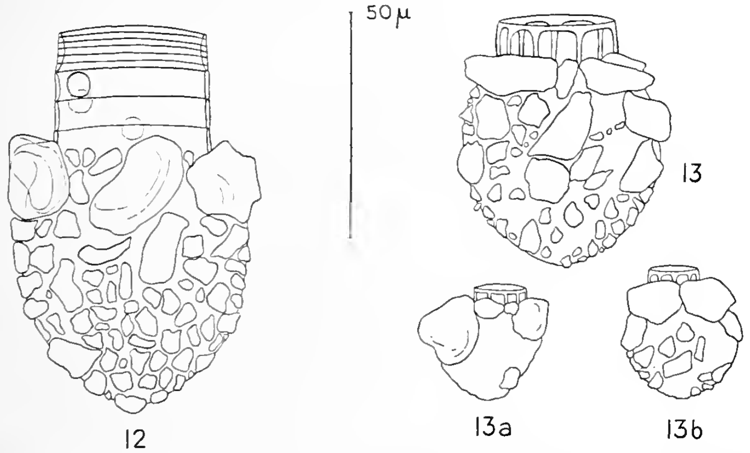
OCCURRENCE.—Common all year, abundant in August, November and March. One of the commonest tintinnids in these waters.

DISTRIBUTION.—The Red Sea and Arabian Sea; the Indian Ocean; the Malay Archipelago; off Zanzibar; the Gulf of Siam; off the coast of Borneo.

REMARKS.—This species is distinguished by a long collar, built up of a fenestrated spiral lamina whose edge can be seen as a line between the rows of fenestrae. The bowl is ovate often with projecting shoulders where the collar and bowl join, and is covered with agglomerated particles, often large. The collar is slightly everted at the oral end, and

sometimes, especially when it is long, narrows slightly where it meets the bowl. The number of turns in the spiral lamina varies greatly, every number from 3 to 15 being counted from a single tow-netting (Station 51). Brandt records the number of turns as 3–6, usually 4 or 5, but sometimes 9–12. Schmidt has recorded specimens from the Gulf of Siam with as many as 18. The top and, less frequently, the bottom turn of the spiral of fenestrae is sometimes incomplete or has fenestrae markedly smaller than the rest. The lamina usually makes several free turns (*i. e.* without fenestrae) just below the mouth. There may be several free turns at the foot of the collar also. Brandt (1907) has pointed out that the fenestrae are not really holes, but that the wall is much thinner there. He has given a good figure of the species (1906, pl. xiv, fig. 2).

Dimensions.—The total length depends almost entirely on the length of the collar, 99μ (3 turns)–189μ (13–15 turns); diameter at mouth 38–42μ. Bowl a little longer than wide, 59–77μ long by 60–65μ wide.



Text-figs. 12, 13.—12. *Codonellopsis indica.* 13, 13*a*, 13*b*. *C. parvicollis.*

Codonellopsis indica, Kofoid and Campbell. Text-fig. 12.

Codonella morchella partim, Brandt, 1906, p. 15, pl. xiii, fig. 3; pl. xiv, fig. 3; 1907, p. 124.
Codonellopsis indica, Kofoid and Campbell, 1929, p. 80, fig. 158.

Occurrence.—Present throughout the year, but was never as common as *C. ostenfeldii.*

Distribution.—Off Zanzibar; off Borneo.

Remarks.—This species differs from the last in the much smaller number and irregular arrangement of fenestrae on the collar. The agglomerated particles are often very large, especially on the shoulders, as is shown in Brandt's second figure (pl. xiv, fig. 3). This species seems to differ very little from *C. americana*, Kofoid and Campbell, and *C. orientalis*, Hada (1932), the distinguishing characters being only slight differences in the shape of the bowl, which, in the Great Barrier Reef material, is rather variable.

C. americana is described as having a more rotund bowl, and *C. orientalis* a more pointed aboral end.

Dimensions.—Total length 73–94μ; length of collar 21–39μ; diameter at mouth 30–36μ; dimensions of bowl 47–60μ long by 44–54μ wide; 6–12 spiral turns on the collar with 1–3 scattered fenestrae.

Codonellopsis parvicollis, n. sp. Text-fig. 13.

Occurrence.—Appeared throughout the year.

Distribution.—The Great Barrier Reef region.

Description.—The total length is a little more than twice the oral diameter. The bowl is ovate, a little longer than wide, and is thickly covered with agglomerated particles, frequently of large size and irregular shape. These agglomerations are often particularly large on the shoulders just below the collar, as is shown in Text-figs. 13*a* and 13*b*.

The collar is short and has only one row of fenestrae, usually 6 or 7 in number. They are irregular in shape, and are usually rectangular rather than circular or oval. In only one specimen one or two irregular fenestrae were seen below the usual single circle.

The species is a little reminiscent of Daday's (1886) *Dictyocysta ovalis*, but the shape of the collar is different, and the present species has never been seen with coccoliths. It differs from the other species of the genus in the short collar.

Dimensions.—Total length 48–61μ ; dimensions of bowl 43–56μ long by 39–51μ wide ; height of collar 5–9μ (13 in the specimen with a double row of fenestrae) ; diameter at mouth 22–29μ.

Codonellopsis brevicaudata (Brandt).

Codonella brevicaudata, Brandt, 1906, pp. 3, 14, pl. iv, fig. 19, pl. xi, fig. 7 ; pl. xii, figs. 2 and 2*a* ; 1907, p. 118.

Codonellopsis brevicaudata, Kofoid and Campbell, 1929, p. 77, fig. 178.

Occurrence.—Seen only in the catch from off Lizard Island, in February.

Distribution.—Pacific Ocean, near New Pomerania.

Remarks.—The single specimen seen agreed in all respects with those described and figured by Brandt.

Dimensions.—Total length 178μ ; length of collar 101μ ; diameter at mouth 53μ ; dimensions of bowl 77μ long by 60μ wide ; 20 spiral turns on collar.

Climacocylis scalaria (Brandt), Jörgensen.

Cyttarocylis (*Coxliella*) *scalarius*, Brandt, 1906, pl. xxi, fig. 15 ; pl. xxvi, figs. 4–6 ; pl. xxvii, figs. 2, 3 ; 1907, pp. 264–267.

Climacocylis scalaria, Kofoid and Campbell, 1929, p. 93, fig. 185.

Occurrence.—In Papuan Pass in February.

Distribution.—Widely distributed in the Atlantic ; also obtained off Madagascar and in the Pacific.

Remarks.—The lorica of the genus *Climacocylis* is very inconspicuous and may easily be overlooked. It consists of a cylindrical tube, open at the aboral end, which is expanded into a large irregular mass or frill. A spiral band is visible on the cylindrical part, and this band bears a projecting ridge or shelf. The shelf becomes wider towards the aboral end. The secondary structure is well marked and consists of large irregularly hexagonal meshes, but the lorica as a whole is extraordinarily delicate and transparent.

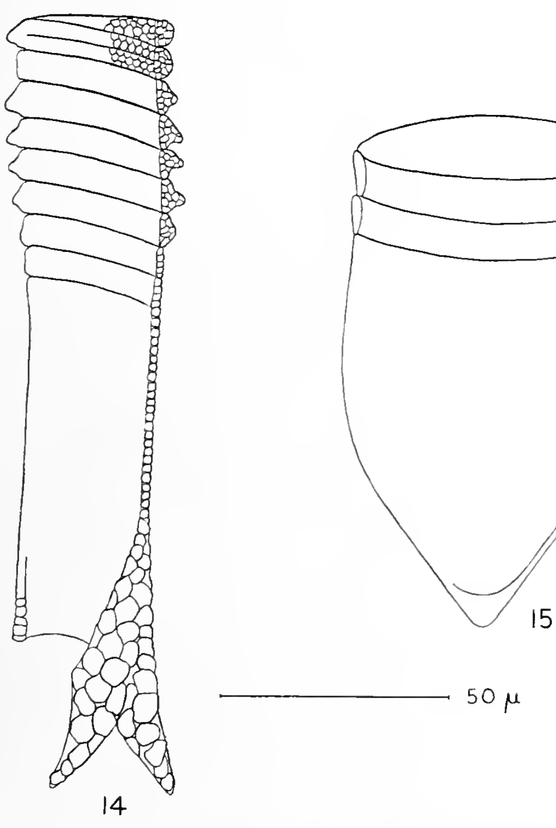
Dimensions.—Length, excluding frill, 181–258μ ; length of frill 65–86μ ; diameter at mouth 47–52μ ; number of spiral turns 4–13.

Climacocylis scalaroides, Kofoid and Campbell. Text-fig. 14.

Cyttarocylis scalarius var. a, Brandt, 1907, pp. 266–267.
Climacocylis scalaroides, Kofoid and Campbell, 1929, pp. 93, fig. 187.

OCCURRENCE.—At Trinity Opening in August and November; in Papuan Pass in February; and at the weekly station occasionally during the year.

DISTRIBUTION.—The Pacific, in the California Current, North Equatorial Current, Panamic area and South Equatorial Current; south-west of Australia; Bay of Biscay and Mediterranean; off Madagascar; the junction of the Labrador and Florida Currents.



TEXT-FIGS. 14, 15.—14. *Climacocylis scalaroides*. 15. *Favella azorica*.

REMARKS.—The lorica of this species also is very delicate and transparent. It is narrower and usually smaller than the preceding species. The spiral band is restricted to the upper part and may show from five to ten turns. Of these the lowest one or two are usually flat, but the rest are produced into a rounded ridge. The lorica may be cylindrical or may narrow a little towards the aboral end, but this is partially closed by a great thickening in the wall. There are almost always one or, more frequently, two triangular prolongations from one side of the aboral end. The secondary structure is similar to that of the preceding species and the meshes become very large in the caudal prolongations. The species as described by Kofoid and Campbell does not have these caudal flaps, but they are not invariably present and the form otherwise agrees very well.

Dimensions.—Length 90–224μ ; diameter at mouth 30–37μ ; number of spiral turns 4–17. One specimen was found measuring 271μ in length and 56μ in oral diameter. It had no caudal prolongation. In structure (apart from the aboral end) it resembled *C. scalaroides*, but in dimensions was nearer to *C. scalaria*.

Coxliella laciniosa (Brandt).

Cyttarocylis ? (Coxliella) ampla (?) var. a, *laciniosa*, Brandt, 1906, p. 20, pl. xxviii, figs. 1, 2, 4 ; pl. xxix, fig. 3 ; *Cyttarocylis ? (Coxliella) laciniosa*, 1907, p. 270.
Coxliella laciniosa, Kofoid and Campbell, 1929, p. 100, fig. 193.

Occurrence.—Very rare. Found singly in Papuan Pass, and in March at the weekly station.

Distribution.—Widely distributed in the warm regions of the Atlantic ; the Mediterranean ; the Indian Ocean (off Madagascar) and the western Pacific (New Pomerania).

Remarks.—The two specimens observed are slightly wider towards the foot of the bowl than at the mouth, and end in a short blunt pedicel. The wall is thick at the mouth and thins out aborally but, unlike Brandt's specimens, is built up with only one layer of primary structure meshes. The primary meshes are small near the mouth, increase in size in the second and remain large in the third, fourth and fifth turn from the mouth. After this they decrease. There are numerous oval fenestrae between the sixth and seventh spiral turns.

Dimensions.—Length 93 and 95μ ; diameter at mouth 60 and 58μ ; greatest width 64μ ; wall about 3μ thick near mouth ; 8 spiral turns.

Favella azorica (Cleve), Jörgensen. Text-fig. 15.

Undella azorica, Cleve, 1900, p. 974, fig. (10).
Favella azorica, Kofoid and Campbell, 1929, p. 151, fig. 284.

Occurrence.—Rare. Appeared occasionally throughout the year.

Distribution.—The Azores ; the Mediterranean ; the Persian Gulf ; the Gulf of Siam ; the Fukien Strait.

Remarks.—The lorica is campanulate and is nearly twice as long as broad. It is almost cylindrical in the upper half to two-thirds and then tapers to a blunt, solid point. There are usually one or two annuli present at the oral end, but these may be absent. The two lamellae of the wall are not distinct, as in Jörgensen's specimens.

Kofoid and Campbell suggest that this may be a *Proplectella* sp., but the secondary structure is that typical of *Favella*, and there seems no reason to doubt Jörgensen's classification. Cleve's original figure shows no annuli, but these are not always present and the shape and size agree well. *F. composita* (Jörgensen) is similar in shape and the possession of annuli, but these are numerous and very narrow.

Dimensions.—Length 73–107μ ; diameter at mouth 47–65μ ; number of annuli none, 1 or 2.

Epiplocylis ralumensis (Brandt).

Ptychocylis reticulata var. *ralumensis*, Brandt, 1906, pp. 28, 29 ; pl. lviii, figs. 3, 8 ; 1907, p. 289.
Epiplocylis ralumensis, Kofoid and Campbell, 1929, p. 184, fig. 320.

Occurrence.—Very rare. One specimen from the station off Lizard Island, and one in March from the weekly station.

Distribution.—The western tropical Pacific.

Remarks.—The two specimens seen were a little shorter than Brandt's, but otherwise resembled his figure closely.

Dimensions.—Length 69–73μ ; diameter at mouth 47–49μ and (including collar) 57μ.

Epiplocylis healdi, Kofoid and Campbell. Text-fig. 16.

Epiplocylis healdi, Kofoid and Campbell, 1929, p. 180, fig. 321.

Occurrence.—Present throughout the year.

Distribution.—The Peruvian Current, Mexican Current, Panamic area, South Equatorial Drift and Galapagos Eddy.

Remarks.—This is the most abundant species of the genus in the Great Barrier Reef material. It is rather variable in form (perhaps because the lorica is thin and easily distorted) and also in its secondary structure. The mouth is double with an erect inner and a spreading outer collar. In most cases there are reticulations on the lower third of the bowl, and from these a number of vertical anastomosing striæ, about 10–17 across one face, run to, or almost to, the collar. The anastomoses vary, however, and are sometimes so frequent that the whole bowl appears to be reticulated, in which case the structure resembles that of *E. reticulata* (Ostenfeld and Schmidt), Jörgensen. Intermediate cases are also seen. At the lip of the collar the primary structure is coarse and consists of large meshes, but it rapidly becomes very fine. Two varieties of shape are shown in Text-figs. 16 and 16*a*.

Dimensions.—Length 65–77μ ; diameter at mouth 43–48μ and (including collar) 52–54μ.

Epiplocylis constricta, Kofoid and Campbell.

Ptychocylis undella var. c, Brandt, 1906, p. 29, pl. lix, fig. 2 ; 1907, p. 295.
Epiplocylis constricta, Kofoid and Campbell, 1929, p. 177, fig. 333.

Occurrence.—Rare. In August, at the weekly station.

Distribution.—Off Ralum in the western, and also in the eastern, Pacific.

Remarks.—The species agrees closely with Brandt's figure. It is not so straight sided as *E. undella*, and the secondary structure is much finer than in *E. deflexa*.

Dimensions.—Length 90–112μ ; diameter at mouth 60μ ; pedicel 15–24μ.

Epiplocylis exigua, Kofoid and Campbell. Text-fig. 17.

Epiplocylis exigua, Kofoid and Campbell, 1929, p. 178, fig. 337.

Occurrence.—Rare. Occurred only in Trinity Opening, a passage through the Great Barrier Reef.

Distribution.—The Pacific, in the South Equatorial Drift and the Peruvian Current.

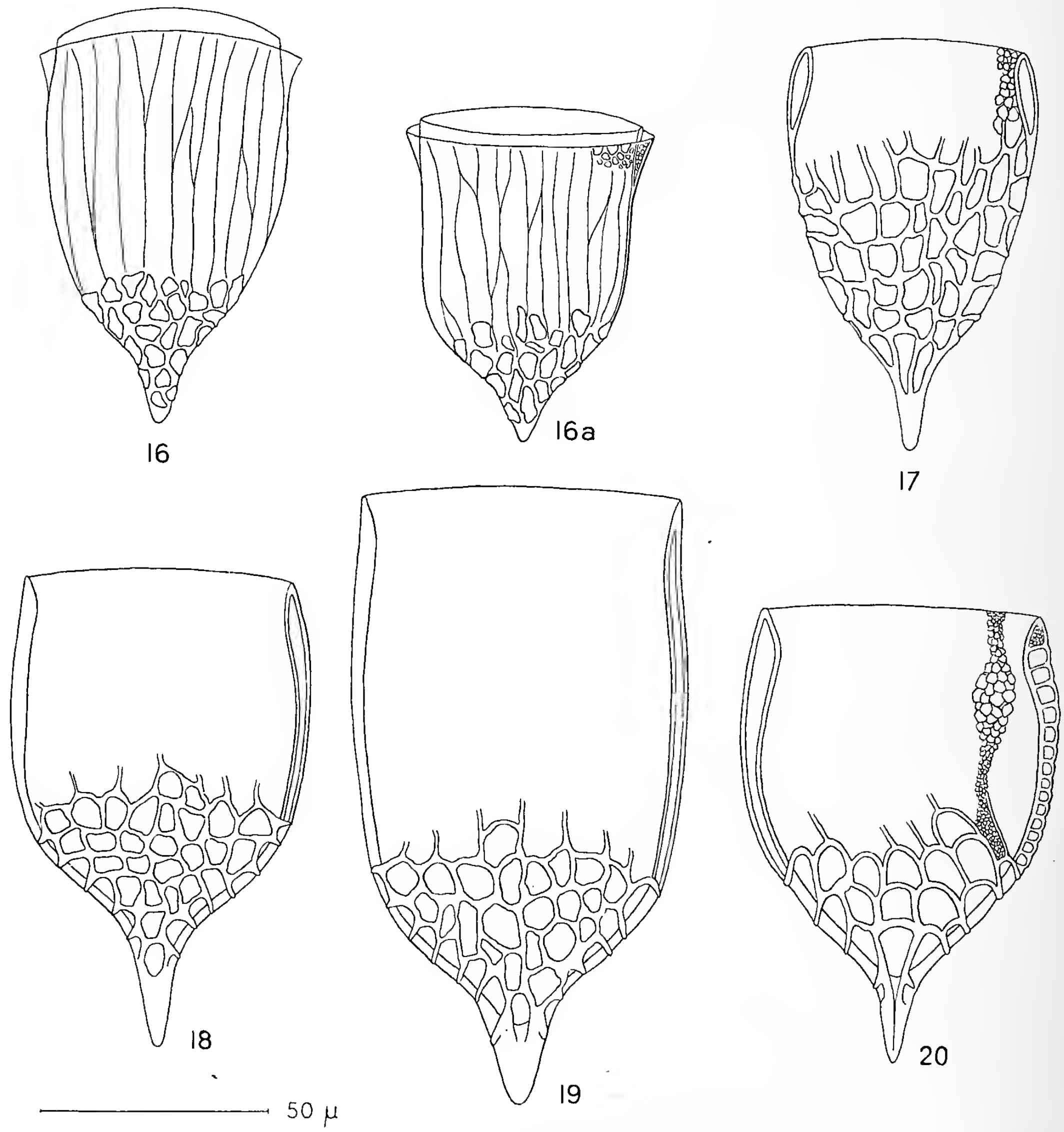
Remarks.—This rare form resembles both *E. exigua*, Kofoid and Campbell, and *E. labiosa*, Kofoid and Campbell (*Ptychocylis calyx*, var. b, Brandt, 1906, pl. lviii, figs. 13, 13*a*). I have put it in the former species because of the longer and more gradual sub-oral thickening, and because the reticulation is absent on the upper quarter of the bowl (·25–·40 in *E. exigua*, ·20 in *E. labiosa*, according to Kofoid and Campbell).

Dimensions.—Total length 88μ ; diameter at mouth 48μ ; pedicel 22μ.

Epiplocylis blanda (Jörgensen), Kofoid and Campbell. Text-fig. 19.

Epiplocylis undella var. *blanda*, partim, Jörgensen, 1924, p. 54, fig. 62.
Epiplocylis blanda, Kofoid and Campbell, 1929, p. 176, fig. 341.

Occurrence.—In Papuan Pass and off Lizard Island in February; rarely at the weekly station in February and March.



Text-figs. 16–20.—16, 16*a*. *Epiplocylis healdi*. 17. *E. exigua*. 18. *E. undella*. 19. *E. blanda*. 20. *E. deflexa*.

Distribution.—The Mediterranean; the Sargasso Sea.

Remarks.—This species is the largest of the genus *Epiplocylis* in these waters. The lower part of the bowl is covered with strong coarse reticulations, which end in free, vertical ribs. The upper two-thirds is covered with very fine reticulations, which are slightly larger in the middle of the bowl.

Dimensions.—Length 120–155μ; diameter at mouth 65–90μ, usually about 70μ; pedicel 26–32μ.

Epiplocylis undella (Ostenfeld and Schmidt). Text-fig. 18.

Cittarocylis Undella, Ostenfeld and Schmidt, 1902, p. 181, fig. 30.
Epiplocylis undella, Kofoid and Campbell, 1929, p. 185, fig. 345.

Occurrence.—In Papuan Pass and off Lizard Island in February; rare at the weekly station in September and March.

Distribution.—The Mediterranean; the Red Sea; the Atlantic.

Remarks.—This species differs from *E. blanda* only in its smaller size.

Dimensions.—Length 103–112μ; diameter at mouth 56–62μ; length of pedicel 26–30μ.

Epiplocylis deflexa, Kofoid and Campbell. Text-fig. 20.

Ptychocylis undella var. b, Brandt, 1906, p. 29, pl. lix, fig. 3; 1907, p. 295, as var. d.
Epiplocylis deflexa, Kofoid and Campbell, 1929, p. 178, fig. 334.

Occurrence.—In Papuan Pass in February and at the weekly station in March.

Distribution.—New Pomerania and the eastern Pacific.

Remarks.—This is an oceanic form found only rarely inside the Great Barrier Reef. It is smaller and more angular than the two preceding species, and the reticulation over most of the bowl is much coarser. The free ribs are directed to the left. The shape is sometimes less angular than shown.

Dimensions.—Length 95–112μ; diameter at mouth 56–73μ; pedicel 16–24μ.

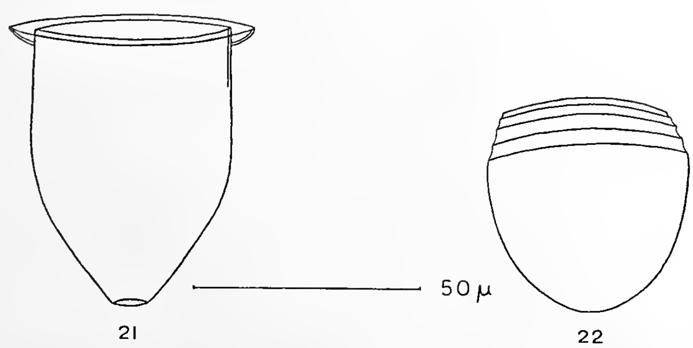
Craterella aperta, n. sp. Text-fig. 21.

Occurrence.—Rare. In January and March at the weekly station, in Papuan Pass and off Lizard Island.

Distribution.—The Great Barrier Reef region.

Description.—The lorica is campanulate, almost cylindrical in the upper third to half, then contracting to an aboral opening. There is a double collar, the outer one flaring and the inner erect. The wall is thin and hyaline. This species differs from all others of the genus *Craterella* in the possession of a wide aboral opening.

Dimensions.—Length 56–65μ; diameter of mouth (inner collar) 43–45μ; diameter of outer collar 52–55μ; aboral opening 7–9μ.



Text-figs. 21, 22.—21. *Craterella aperta*. 22. *Metacylis corbula*.

Metacylis corbula, Kofoid and Campbell. Text-fig. 22.

Metacylis corbula, Kofoid and Campbell, 1929, p. 199, fig. 376.

OCCURRENCE.—Rare. In December and March at the weekly station and off Lizard Island in February.

DISTRIBUTION.—The Bay of Panama.

REMARKS.—The lorica is as wide as long, and is broadly rounded aborally. The collar, on which there are four or five spiral turns, contracts a little towards the mouth.

DIMENSIONS.—Total length 39–43μ ; diameter at mouth 36–38μ ; greatest diameter 42–44μ ; height of collar about 8μ.

Protorhabdonella simplex (Cleve), Jörgensen.

Cyttarocylis simplex, Cleve, 1900, p. 972, fig. (7).
Protorhabdonella simplex, Kofoid and Campbell, 1929, p. 208, fig. 395.

OCCURRENCE.—It was present during most of the year and was common from May to July, but it was scarce or absent from January to April.

DISTRIBUTION.—The warm regions of the Atlantic ; the coast of Chile ; the Red Sea and Arabian Gulf ; the Gulf of Siam.

REMARKS.—One of the commoner species in the Great Barrier Reef material and frequent in water samples. There are about 7–10 vertical ribs, which do not quite reach the mouth, and the slightly flaring oral rim is marked by a spiral line. The specimens are slightly longer than Jörgensen's, measuring 58–69μ in length compared with his 52–58μ.

DIMENSIONS.—Length 58–69μ ; diameter at mouth 32–38μ.

Protorhabdonella curta (Cleve), Jörgensen.

Cyttarocylis striata, forma *β curta*, Cleve, 1901, p. 922, fig. 3*b*.
Protorhabdonella curta, Kofoid and Campbell, 1929, p. 207, fig. 393.

OCCURRENCE.—Rare. In August, September, March and April at the weekly station and off Lizard Island in February.

DISTRIBUTION.—The Red Sea ; the southern Atlantic ; the Indian Ocean ; the Mediterranean.

REMARKS.—This is a smaller species than the last, and has more numerous though less strongly-marked ribs, which often take a spiral course, especially near the mouth. It is of the same general shape as *P. simplex*.

DIMENSIONS.—Length 39–52μ ; diameter at mouth 24–28μ.

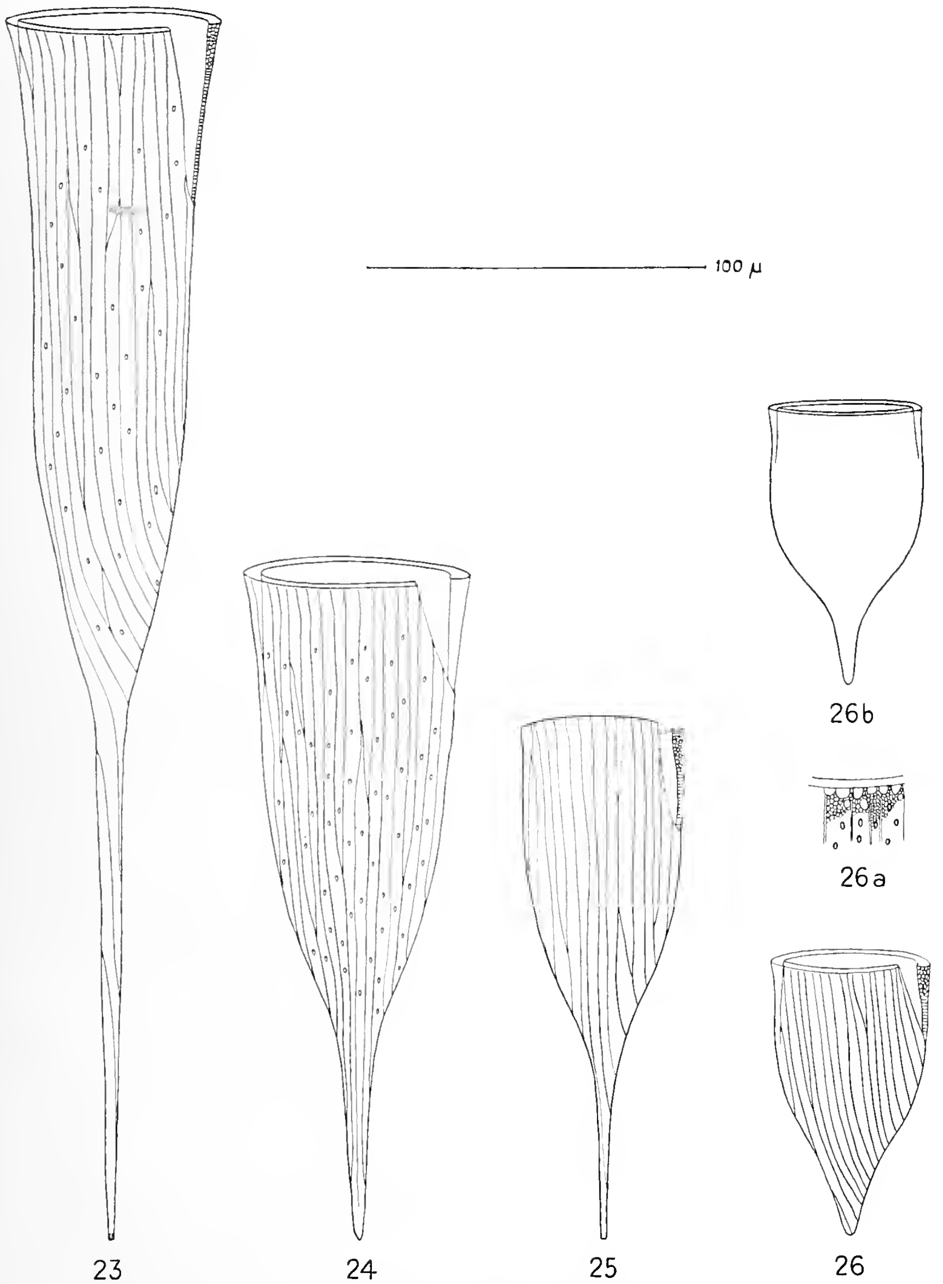
Rhabdonella spiralis (Fol), Brandt. Text-fig. 23.

Ptychocylis (*Rhabdonella*) *spiralis* var. c *indopacifica*, partim, Brandt, 1906, p. 27, pl. liii, figs. 8–10 ;
Rhabdonella spiralis var. c *indopacifica*, Brandt, 1907, p. 326.
Rhabdonella spiralis, Kofoid and Campbell, 1929, p. 219, fig. 414.

OCCURRENCE.—One of the common species in the lagoon of the Great Barrier Reef. It was numerous in July, August and September, and occurred throughout the year, except in December.

Distribution.—Apparently a cosmopolitan species, occurring in the Mediterranean and in the warmer regions of the Atlantic, Indian and Pacific Oceans.

Remarks.—*R. spiralis*, as described by Brandt, was a comprehensive species, con-



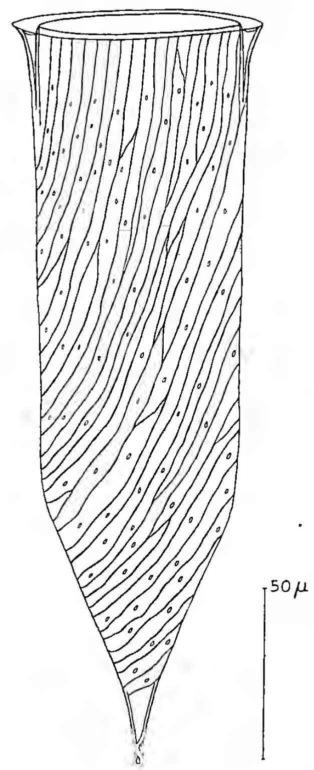
Text-figs. 23–26.—23. *Rhabdonella spiralis*. 24. *R. brandti*. 25. *R. quantula*. 26, 26*a*, 26*b*. *R. amor*.

taining a number of varieties. It has recently been split up by Kofoid and Campbell into a considerable number of new species, some corresponding partly or entirely to Brandt's varieties. Until their full descriptions are published it is not possible to find out on what differences their species are founded. Jörgensen (1924) considers that there is

a great deal of individual variation in the species, and this is confirmed by the Great Barrier Reef material.

The present form agrees well with Brandt's figure of *R. spiralis* var. *indopacifica* and with Jörgensen's *R. spiralis* (1924, fig. 68). It has an oral flare (not always well-marked) and gutter; it is almost cylindrical above and tapering below, and has a long slender pedicel almost half the total length and open at the tip. The striæ run vertically at the top of the bowl and slightly left-handed on its foot. Numerous fenestræ are present between the ribs and the structure of the wall is usually fine.

Dimensions.—Length 266–411μ; length of pedicel 95–224μ; outside diameter of mouth 67–73μ; number of ribs 30–40.



27

Text-fig. 27.—*Rhabdonella spiralis ?*

Rhabdonella spiralis (Fol), Brandt ? Text-fig. 27.

A form found only once, at the weekly station in August, may be a monstrous or a half-developed specimen, such as is described by Jörgensen (1924). The ribs, about 40 in number, run right-handed on the bowl (which is unusual in *Rhabdonella* spp.). There are numerous fenestrae, except just below the mouth. The shape of the bowl resembles that of *R. spiralis*, but it narrows rather abruptly to a short pedicel.

Dimensions.—Total length 215μ; external diameter of mouth 73μ; pedicel 13μ.

Rhabdonella brandti, Kofoid and Campbell. Text-fig. 24.

Ptychocylis (Rhabdonella) amor var. a *cuspidata*, Brandt, 1906, p. 27; pl. liv, figs. 3, 10, 11; Brandt, 1907, *Rhabdonella amor* var. *cuspidata*, p. 331.
Rhabdonella brandti, Kofoid and Campbell, 1929, p. 213, fig. 400.

Occurrence.—Present throughout most of the year, but was much more abundant after March.

Distribution.—In the warm parts of the Atlantic; the Karajak fjord; the Mediterranean; the Red Sea; off Borneo.

Remarks.—This is a smaller form than the preceding, and shows similar slight variations in size and shape. The ribs usually run vertically, but occasionally show a slight left-handed spiral on the foot of the bowl. The oral flare is little marked. The fenestrae are numerous and distinct.

Dimensions.—Length 158–198μ, usually 170–190μ, of which the pedicel forms from a quarter to a little less than half; external diameter at mouth 60–69μ; about 28–35 ribs, fenestrae numerous.

Rhabdonella quantula, Kofoid and Campbell. Text-fig. 25.

Rhabdonella quantula, Kofoid and Campbell, 1929, p. 218, fig. 402.

Occurrence.—Appeared mostly at stations near the outer reefs, especially in Papuan Pass, but was present at the weekly station in September and October, and once in March.

Distribution.—The Mexican, Californian, South Equatorial, Equatorial Counter and North Equatorial Currents; the Panamic area, Galapagos Eddy and South Equatorial Drift.

Remarks.—This species is like *R. brandti* in general appearance, but is more slenderly built and has a better defined pedicel. Its range of size is greater, but on the whole the specimens are smaller. The ribs are vertical or slightly left-handed, the tip of the pedicel is usually open and fenestrae are often present, although sometimes faint and difficult to see. The ribs are fewer than in Kofoid and Campbell's specimens. It is apparently restricted to more oceanic conditions than *R. brandti* and *R. spiralis*.

Dimensions.—Length 104–172μ; outside diameter at mouth 40–52μ; number of ribs 20–35, usually 30–35.

Rhabdonella amor (Cleve), Brandt. Text-fig. 26.

Cittarocylis Amor, Cleve, 1900, pp. 970–971, fig. (4).
Rhabdonella amor, Kofoid and Campbell, 1929, p. 212, fig. 398.

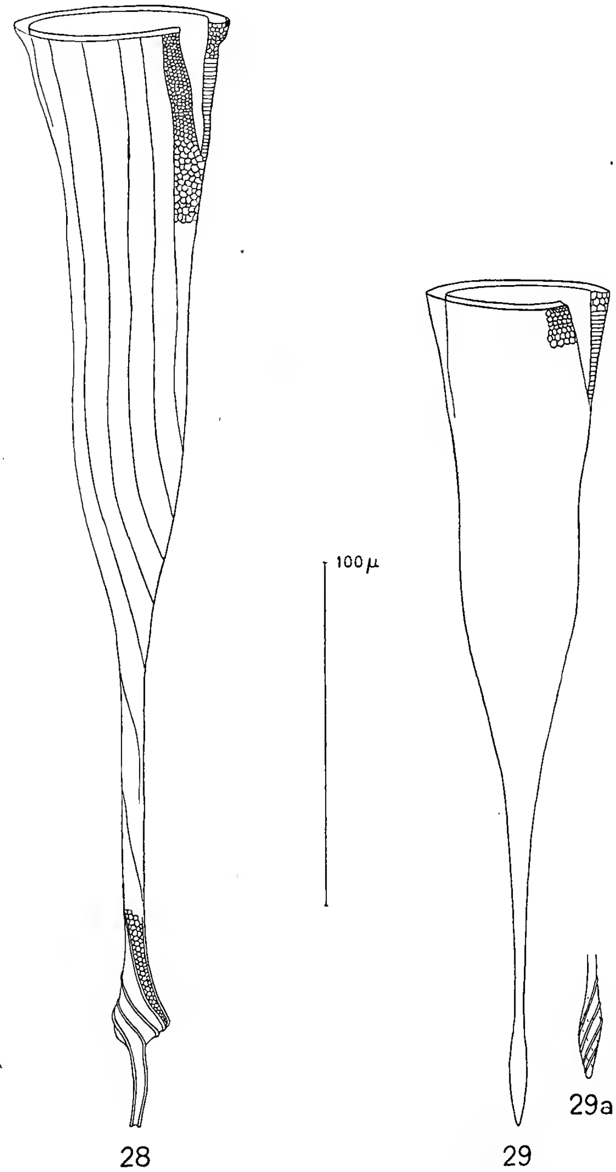
Occurrence.—Present throughout the year at the weekly station, more commonly after March, and also at the stations on the Outer Barrier Reefs.

Distribution.—Widely distributed in the warmer parts of the Atlantic and in the Indian Ocean, the Mediterranean and the Karajak fjord.

Remarks.—This is the smallest of the *Rhabdonella* species in the Great Barrier Reef material. It varies in shape, but the pedicel, although better defined than in Kofoid and Campbell's figure, is not usually so well marked off as in the other species. Text-figs. 26 and 26*b* show variations in shape; the pedicel is sometimes even less marked than in Text-fig. 26. The oral flare is only slight. There are 30–44 ribs, usually running in a

left-handed spiral on the foot of the bowl. The fenestrae, when present, are small and sometimes difficult to see. In many specimens the meshes at the oral lip are large (Text-fig. 26*a*), but these rapidly give way to small meshes and the structure over most of the bowl is very fine.

DIMENSIONS.—Length 77–92μ ; external diameter of mouth 45–55μ.



TEXT-FIGS. 28, 29.—28. *Rhabdonellopsis intermedia.* 29, 29*a*. *Xystonella lanceolata.*

Rhabdonellopsis intermedia, Kofoid and Campbell. Text-fig. 28.

Rhabdonellopsis intermedia, Kofoid and Campbell, 1929, p. 223, fig. 424.

OCCURRENCE.—Rare. Present at the weekly station in August, September and October, 1928, in March and June, 1929, and at most stations on the outer Barrier. It is thus confined to water of a fairly high salinity.

Distribution.—The Pacific Ocean in the Californian, Mexican, Peruvian and South Equatorial Currents; the Panamic area and Galapagos Eddy.

Remarks.—The genus *Rhabdonellopsis* is widely distributed in warm oceanic waters. It has been divided by Kofoid and Campbell into six species, of which the present forms most closely resemble *R. intermedia*. They resemble also Brandt's *Rhabdonella apophysata* var. *b*, except in the occasional presence of fenestrae, which seems to be a variable character, and in the striae, which are less spirally twisted.

The oral flare is marked; the ribs, 12–17 in number, are almost vertical, showing only a slight left-handed twist on the foot of the bowl and the pedicel. They continue to the knob, where they are often well marked. The pedicel is open at the tip. The development of the knob on the pedicel varies considerably, from a simple knob to a structure 14μ in diameter, with well-marked ribs and secondary mesh-work.

On the bowl the secondary structure is very fine at the oral lip, enlarges on the body to a coarse hexagonal mesh-work, and diminishes again on the pedicel.

Dimensions.—Length 240–370μ (usually 250–300μ); external diameter at mouth 60–75μ; pedicel 116–180μ (usually 116–140μ); fenestrae few and small, not always visible; diameter of knob 9–14μ.

Xystonella lanceolata (Brandt), Brandt. Text-fig. 29.

Cytarotcylis? (Xystonella) lanceolata, partim, Brandt, 1906, pp. 7, 24, pl. xlii, fig. 4–7; *(Cyttarocylis?) Xystonella lanceolata*, Brandt, 1907, p. 258.
Xystonella lanceolata, Kofoid and Campbell, 1929, p. 236, fig. 449.

Occurrence.—Rare. Only in August, September and October and at stations on the Great Barrier Reef.

Distribution.—The Atlantic and Indian Oceans; the Mediterranean.

Remarks.—This species is rather variable in form. The oral flare is sometimes present and sometimes not. The pedicel is always more refractive than the very delicate upper part of the lorica, and stands out from it clearly. The secondary mesh-work, always visible in these specimens as in Jörgensen's (1924), is very small near the mouth, large over the greater part of the bowl and diminishes towards the pedicel. On this, when visible, the meshes are longer in shape. The pedicel is usually enlarged into a spindle-shaped swelling near the foot, on which the ribs run diagonally (Text-fig. 29*a*) or form a mesh-work, but occasionally the swelling shows no structure, and it may be entirely absent.

Dimensions.—Length 215–275μ; external diameter of mouth 53–60μ; pedicel 65–95μ.

Xystonella treforti (Daday), Laackmann.

Cyttarocylis Treforti, Daday, 1887, p. 597, pl. xxi, fig. 1.
Xystonella treforti, Kofoid and Campbell, 1929, p. 238, fig. 452.

Occurrence.—Very rare. In Papuan Pass, and off Lizard Island, in February, and once at the weekly station in March.

Distribution.—Mediterranean, Atlantic, Indian and Pacific Oceans.

Remarks.—This is a larger species than the last, and agrees well with Brandt's description and figure (Brandt, 1906, pl. xlviii, fig. 1).

Dimensions.—Length 405–469μ; external diameter of mouth 76–80μ; greatest diameter of body 75–86μ.

Undella hemispherica, Laackmann. Text-fig. 30.

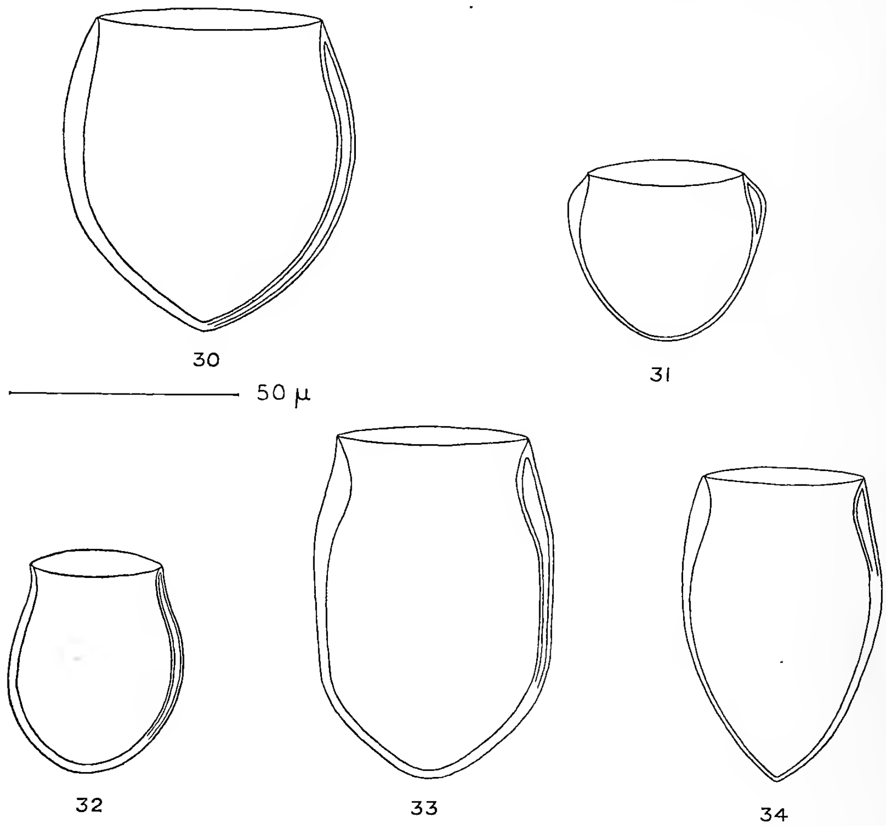
Undella hemispherica, Laackmann, 1910, pp. 468, 471, 472–3, 493, pl. xlix, fig. 22.
Undella hemispherica, Kofoid and Campbell, 1929, p. 263, fig. 505.

Occurrence.—Very rare. In October and March at the weekly station and off Lizard Island in February.

Distribution.—The tropical Atlantic.

Remarks.—This rare form resembles a *Proplectella*, but has no thickening of the wall to form an inner collar, and is almost as wide as long. A fine primary reticulation can be made out, especially near the mouth.

Dimensions.—Length 65–69μ ; diameter at mouth 47–53μ ; greatest width 62–65μ.



Text-figs.—30–34.—30. *Undella hemispherica.* 31. *U. turgida.* 32. *Proplectella perpusilla.* 33. *P. tenuis.* 34. *P. acuta.*

Undella turgida, Kofoid and Campbell. Text-fig. 31.

Undella turgida, Kofoid and Campbell, 1929, p. 266, fig. 502.

Occurrence.—Very rare. One specimen seen from the catch off Lizard Island in February.

Distribution.—The eastern tropical Pacific.

Remarks.—The single specimen seen agreed exactly with Kofoid and Campbell's figure except that it was slightly smaller and had a distinct reticulation, the meshes being small at the oral lip, and slightly larger at the widest part of the bowl.

Dimensions.—Length 37μ ; diameter at mouth 35μ.

Proplectella tenuis, Kofoid and Campbell. Text-fig. 33.

Undella claparèdei var. c, Brandt, 1906, p. 31, pl. lxiv, figs. 5, 6, 7 ; 1907, pp. 348, 349, 363, 364.
Proplectella tenuis, Kofoid and Campbell, 1929, p. 283, fig. 536.

Occurrence.—Rare except from February till May and at stations on the outer barrier. It was then present only in small numbers.

Distribution.—The tropical Atlantic ; the Indian Ocean south of Madagascar.

Remarks.—This was the commonest species of the genus *Proplectella* in the Great Barrier Reef material. The lorica is ovate, expanding below the mouth to its widest at about a third of the length from the mouth. The sides are slightly flattened, and the aboral end is usually rounded, sometimes slightly angular. A fine reticulation can be made out in most specimens.

Dimensions.—Length 69–76μ ; diameter at mouth 40–45μ ; greatest width 49–56μ.

Proplectella perpusilla, Kofoid and Campbell. Text-fig. 32.

Proplectella perpusilla, Kofoid and Campbell, 1929, p. 281, fig. 524.

Occurrence.—Very rare. In March and April at the weekly station.

Distribution.—The Galapagos Eddy and widely in the eastern tropical Pacific.

Remarks.—This is a smaller form than the last and is widest in the expanded aboral half. Only a few specimens were seen.

Dimensions.—Length 47–49μ ; diameter at mouth 27–30μ ; greatest width 37–38μ.

Proplectella acuta (Jörgensen). Text-fig. 34.

Undella subacuta forma *acuta*, Jörgensen, 1924, pp. 39–41, fig. 43*a*.
Proplectella acuta, Kofoid and Campbell, 1929, p. 273, fig. 545.

Occurrence.—Very rare. In October at the weekly station.

Distribution.—The Mediterranean.

Remarks.—This species differs from the others in the genus in its acutely pointed aboral end. The wall is much thinner in the aboral than in the oral half. Only a single specimen was seen.

Dimensions.—Length 65μ ; diameter at mouth 38μ ; greatest diameter 47μ.

Dictyocysta reticulata, Kofoid and Campbell.

Dictyocysta Templum, Daday, 1887, p. 585, pl. xxi, figs. 8, 9.
Dictyocysta reticulata, Kofoid and Campbell, 1929, p. 300, fig. 560.

Occurrence.—Rare. Found at the weekly station in March, April and May, and in samples from Trinity Opening and Papuan Pass.

Distribution.—The Mediterranean ; the Indian Ocean ; the eastern tropical Pacific.

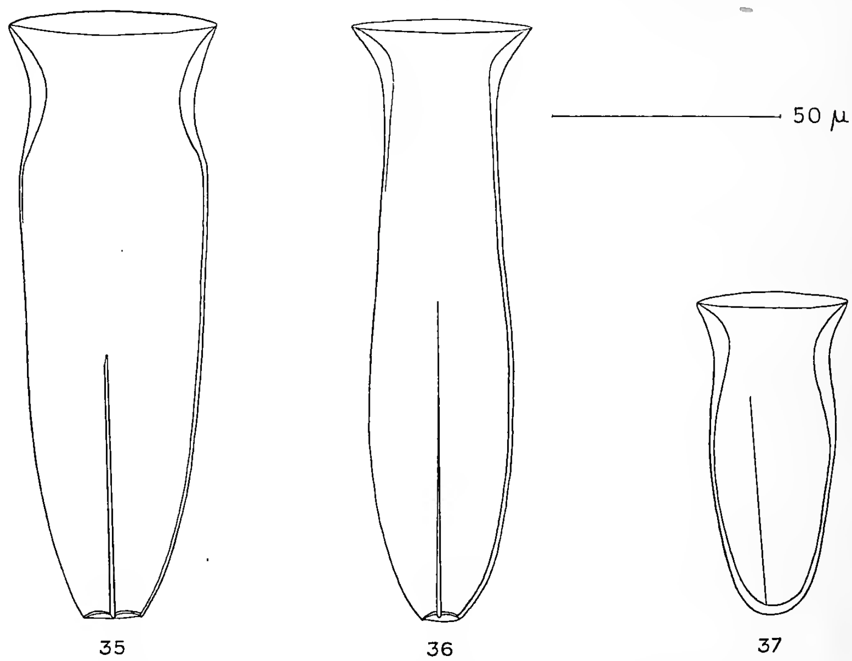
Remarks.—There is a good figure of this species in Brandt (1906, pl. iii, fig. 8). The collar is a little more than a third of the whole length, and the bowl is widest just below the collar and is bluntly pointed aborally. There are usually 6, but occasionally 7, large angular windows in the collar. A little below the widest part of the bowl there are usually two circles of fenestrae. Sometimes, however, only one circle is present, and

occasionally there are no fenestrae at all. The number in each circle is variable, the top one having 6 to 9, and the lower usually only 2 or 3, smaller and less regular. This lower incomplete circle is not mentioned by Kofoid and Campbell, although there is an indication of it in Brandt's fig. 8 and in Daday's fig. 8. The rest of the bowl is made up of very regular polyhedral reticulations. One specimen showed very small projections all along the oral margin of the collar.

DIMENSIONS.—Total length 58–65μ ; diameter at mouth 37–43μ ; height of collar 20–25μ ; length of bowl 34–45μ ; greatest width of bowl 43–48μ.

Amphorella quadrilineata (Claparède and Lachmann), Daday. Text-fig. 35.

Tintinnus quadrilineatus, Claparède and Lachmann, 1858, p. 201, pl. ix, fig. 3.
Amphorella quadrilineata, Kofoid and Campbell, 1929, p. 311, fig. 587.



TEXT-FIGS. 35–37.—35. *Amphorella quadrilineata*. 36. *A. brandti*. 37. *A. minor*.

OCCURRENCE.—Present throughout the year and was common in February and March.

DISTRIBUTION.—Has a wide distribution in northern temperate waters, as well as in the Mediterranean and the warm parts of the Atlantic, Indian and Pacific Oceans.

REMARKS.—This species has three well-marked fins, which run from the aboral end up towards the mouth. Their length is variable ; usually they extend half or two-thirds of the way up, but they occasionally run right up to the mouth. The lorica narrows, and its wall is much thickened just below the mouth. It is widest in the upper third, a little below the neck, and narrows gradually to a truncated tip. Although this thickening of the wall of the lorica is very characteristic, it varies considerably and may occasionally be quite absent.

DIMENSIONS.—Total length 108–145μ (usually over 130μ) ; diameter at mouth 45–54μ ; diameter at neck 37–43μ ; greatest diameter of body 38–43μ.

Amphorella brandti, Jörgensen. Text-fig. 36.

Tintinnus amphora, Brandt, 1906, p. 33, pl. lxix, fig. 6; 1907, partim, pp. 433–434.
Amphorella brandti, Kofoid and Campbell, 1929, p. 309, fig. 588.

Occurrence.—Present throughout the year and was common in February and March.

Distribution.—The Atlantic; Mutsu Bay in Japan.

Remarks.—This species is a more slender form than the preceding, flares more towards the mouth and is usually rather longer. Although the dimensions of the oral part remain pretty constant, the length varies considerably. Three fins are present, as in the last species. The lorica is widest in its lower third, and then narrows to a truncated tip. No primary or secondary structure was ever visible.

Dimensions.—Total length 107–190μ (usually 130–160μ); diameter at mouth 38–45μ; diameter at neck 22–28μ; greatest diameter of body 29–35μ.

Amphorella laackmanni, Jörgensen.

Tintinnus amphora var. *dadayi*, Laackmann, 1910, pp. 486–487, 493, pl. l, fig. 12.
Amphorella laackmanni, Kofoid and Campbell, 1929, p. 310, fig. 591.

Occurrence.—Very rare. Off Lizard Island in February, and at the weekly station in March.

Distribution.—The Mediterranean; the tropical Atlantic.

Remarks.—The few specimens seen were longer than Jörgensen's (1924, p. 19, fig. 14) from the Mediterranean (from the stomach of Salps), but agree with his description otherwise. The four ribs from the oral end do not join up with the four from the aboral end.

Dimensions.—Length 75–84μ; diameter at mouth 20–22μ.

Amphorella minor, Jörgensen. Text-fig. 37.

Amphorella quadrilineata var. *minor*, Jörgensen, 1924, p. 18, figs. 12*a* and 12*b*.
Amphorella minor, Kofoid and Campbell, 1929, p. 310, fig. 590.

Occurrence.—Very rare. In September and October, 1928, and in July, 1929, at the weekly station.

Distribution.—The Mediterranean and the eastern Pacific.

Remarks.—Apart from its small size and the fact that it has a rounded instead of a truncated end, this species is very like *A. quadrilineata*. It thus resembles Jörgensen's drawing rather than Kofoid and Campbell's, which is more like a small *A. brandti*.

Steenstrupiella steenstrupii (Claparède and Lachmann).

Tintinnus Steenstrupii, Claparède and Lachmann, 1858, p. 200, pl. viii, fig. 5.
Steenstrupiella steenstrupii, Kofoid and Campbell, 1929, p. 314, fig. 596.

Occurrence.—Rare. In September, October, November, March and April at the weekly station, and in Trinity Opening in November.

Distribution.—Widely distributed in the Mediterranean, Atlantic and Indian Oceans.

Remarks.—This species is very variable, both in length and in thickness of wall. There is a marked oral flare and sub-oral thickening. The wall of the lorica is usually thick for about two-thirds of the length, but thins out at the aboral end. No striae were visible on about half the specimens, but they were quite clear on the rest.

In general appearance this form agrees with *S. robusta*, Kofoid and Campbell, but occasionally the wall was quite thin, even at the neck (*cf. Amphorella quadrilineata*), and all gradations were found between this and the usual condition. There was no relation between size or presence of striae and thickness, so I prefer to identify all specimens as *S. steenstrupii*. As usual in the family Tintinnidae, the width of the mouth, neck and body generally is much more constant than the total length.

Dimensions.—Length 84–197μ ; diameter at mouth 34–37μ ; diameter at neck 20–24μ ; greatest diameter 13–19μ.

Steenstrupiella intumescens (Jörgensen).

Amphorella intumescens, Jörgensen, 1924, p. 21, fig. 19.
Steenstrupiella intumescens, Kofoid and Campbell, 1929, p. 313, fig. 594.

Occurrence.—Rare. It was seen only in March at the weekly station.

Distribution.—The Mediterranean.

Remarks.—The lorica is long and narrow, with a flaring mouth and a rounded aboral end. Four striae or fins extend from about the middle to the aboral end. In the two specimens described by Jörgensen there was a marked thickening of the wall in the middle of the lorica, which merged gradually into the thin-walled parts above and below. In the present material this thickening is absent in some specimens. The oral end differs from all others in the genus by the complete lack of a sub-oral thickening of the wall.

Dimensions.—Length 172–238μ ; diameter at mouth 34–37μ ; diameter of body in the middle 17–21μ ; length of fins 77–90μ.

Amphorellopsis acuta (Schmidt).

Amphorella acuta, Schmidt, 1902, p. 184, figs. 2*a–c*.
Amphorellopsis acuta, Kofoid and Campbell, 1929, p. 315, fig. 598.

Occurrence.—Rare. At the weekly station in September, October, November, February and March, and off Lizard Island and in Papuan Pass in February.

Distribution.—The Gulf of Siam ; the West African coast.

Remarks.—This species is very like *Amphorella brandti*, except that it is smaller in all dimensions and has a pointed, not a truncated, aboral end. The thickness of the wall is variable.

Dimensions.—Length 76–89μ ; diameter at mouth 29–37μ ; diameter of neck 19–24μ ; greatest diameter of body 22–27μ.

Four longer specimens were seen. Their dimensions were : Length 116–121μ ; diameter at mouth 34–36μ ; diameter of neck 19–25μ ; greatest diameter of body 26–30μ.

Dadayiella ganymedes (Entz Sr.), Kofoid and Campbell.

Tintinnus Ganymedes, Entz Sr., 1884, p. 409, pl. xxiv, figs. 17, 18.
Dadayiella ganymedes, Kofoid and Campbell, 1929, p. 321, fig. 610.

Occurrence.—Rare until November, and was usually present at the weekly station thereafter.

Distribution.—The Mediterranean; widely distributed in the Atlantic; the Indian and Pacific Oceans.

Remarks.—A very delicate species. The ribs number 7–12 and there are sometimes subsidiary shorter ribs between these. None of them extend below the widest part of the bowl. Occasionally the wall of the lorica at the mouth appears to have been destroyed and the ribs are seen sticking out. No marking was observed on the thin-walled pedicel, which is straight and sharply pointed. The length is less than that of the specimens described by Entz from the Mediterranean, and Brandt from the Atlantic. Apart from this, and the lack of ribs on the pedicel, the specimens resemble Brandt's pl. lxx, fig. 2.

Dimensions.—Total length 75–95μ; diameter at mouth 29–30μ; greatest width of bowl 28–30μ; length of pedicel 13–17μ.

Tintinnus attenuatus, Kofoid and Campbell. Text-fig. 38.

Tintinnus lusus-undae var. c, Brandt, 1906, partim, p. 32, pl. lxv, fig. 12; 1907, p. 422, *Tintinnus fraknoi* var. c, 1906, p. 32, pl. lxv, fig. 20; 1907, partim, p. 424.
Tintinnus attenuatus, Kofoid and Campbell, 1929, p. 332, fig. 633.

Occurrence.—Present throughout most of the year except from April to June, but not so common as *T. lusus-undae.*

Distribution.—The Mediterranean; the tropical Atlantic; the Indian Ocean off Madagascar; the western Pacific.

Remarks.—This species agrees well with Brandt's *T. fraknoi* var. c, which has been divided by Kofoid and Campbell between two species, *T. attenuatus* and *T. macilentus.* I have put the present form in the first of these, since it agrees more closely in size, but it usually possesses a slight aboral flare—a feature which, according to Brandt's description (1907, p. 424), was usually present, but might be little marked. This is, however, a variable character (*cf. T. lusus-undae*). The oral funnel is not marked, for the flare is gradual, and it thus resembles Brandt's pl. lxv, fig. 20, rather than pl. lxv, fig. 12. Text-figs. 38 and 38*a* show two specimens with the aboral flare more marked in one than in the other.

The diameter of both oral and aboral end is less than in other similar species (*T. fraknoii*, Daday, *T. elongatus*, Jörgensen).

Dimensions.—Length 228–410μ (usually 320–400μ); diameter at mouth 52–57μ; aboral diameter 17–29μ.

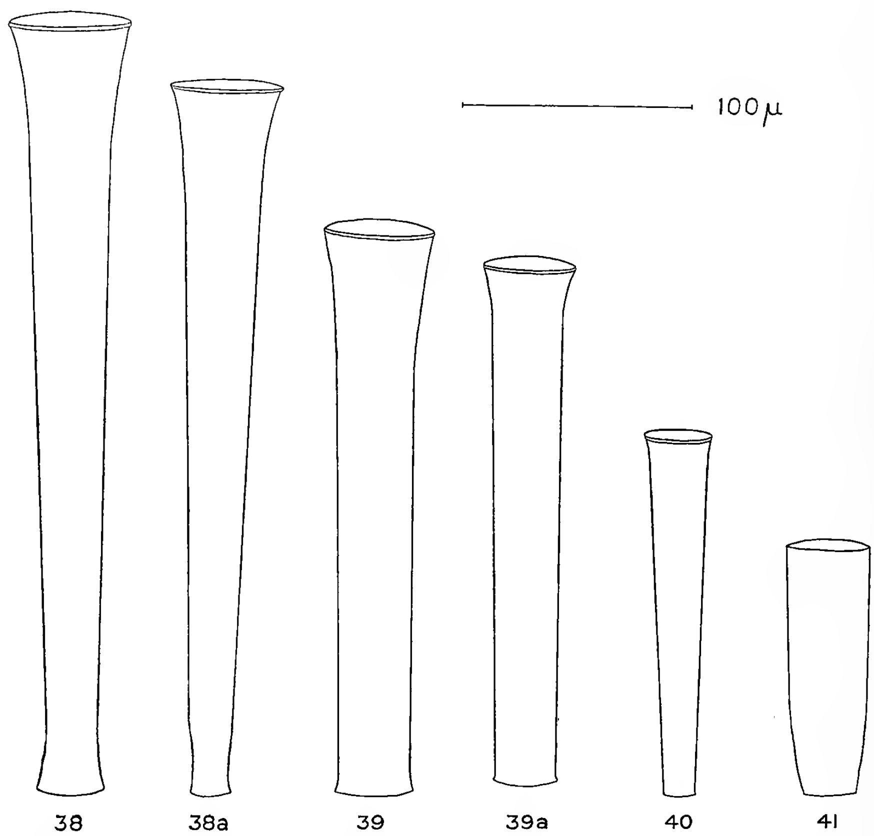
Tintinnus lusus-undae, Entz Sr. Text-fig. 39.

Tintinnus Lusus-undae, Entz Sr., 1885, p. 202, pl. xiv, fig. 12.
Tintinnus lusus-undae, Kofoid and Campbell, 1929, p. 335, fig. 656.

Occurrence.—Present throughout the year and common in August.

Distribution.—The Mediterranean; the tropical Atlantic and the Indo-Pacific region.

Remarks.—Like the rest of the family Tintinnidae, the diameter of this species varies within rather narrow limits, while the length varies considerably. The shape is also variable. The lorica has the form of an open tube, wider at the oral than at the aboral end, but the amount of oral flare varies; there is sometimes a marked brim at the oral edge; the aboral end is usually straight, but there is sometimes a slight flare.



Text-figs. 38–41.—38, 38*a*. *Tintinnus attenuatus*. 39. *T. lusus-undae*. 39*a*. *T. lusus-undae* (slender form). 40. *T. stramentus*. 41. *T. pacificus*.

Fifty specimens were measured and it was found that the measurements fell into two groups. Within each group the total length, the presence or absence of a brim and the amount of oral and aboral flare were equally variable, but one group (Text-fig. 39*a*) was more slender than the other (Text-fig. 39). It is possible that a second species is present (perhaps *T. tenue*, Kofoid and Campbell), but in view of the resemblances otherwise and the fact that a few intermediate specimens were found the two forms are at present kept as one species. The dimensions of the wider form agree well with those of *T. lusus-undae* from elsewhere.

Dimensions.—Wide form: Length 176–298μ; diameter at mouth 51–59μ (usually 52–54μ); diameter at foot 29–35μ (usually 30–33μ); diameter across middle of body 35–43μ (usually 38–39μ).

Slender form: Length 155–277μ; diameter at mouth 34–46μ (usually 43–45μ); diameter at foot 24–29μ (usually 24–27μ); diameter across middle of body 29–33μ (usually 30–32μ).

Intermediate forms: Length 183–191μ; diameter at mouth 47–49μ; diameter at foot 29–30μ; diameter across middle of body 34μ.

Tintinnus stramentus, Kofoid and Campbell. Text-fig. 40.

Tintinnus stramentus, Kofoid and Campbell, 1929, p. 339, fig. 635.

Occurrence.—Appeared occasionally throughout the year, but was not seen after February.

Distribution.—The California Current; the Mexican Current; the Panamic area and South Equatorial Drift of the Pacific.

Remarks.—This species is like a small and slender *T. attenuatus*, but it lacks the oral flare and has only a well-marked brim. The aboral end has usually a very slight flare, but this is sometimes lacking. The sides are straight. Of the specimens measured, several are considerably shorter than the rest, but since the oral dimensions and general shape are the same, they also probably belong to this species.

Dimensions.—Typical: Length 142–176μ; oral diameter 30–31μ; aboral diameter 13–16μ. Others: Length 101–129μ; oral diameter 26–31μ; aboral diameter 11–19μ.

Tintinnus pacificus, Kofoid and Campbell. Text-fig. 41.

Tintinnus pacificus, Kofoid and Campbell, 1929, p. 337, fig. 632.

Occurrence.—Very rare. Occurred in November at the weekly station.

Distribution.—The eastern Pacific, in the South Equatorial Drift.

Remarks.—The few specimens seen were longer than Kofoid and Campbell's specimens, but agree well in general shape. The lorica is almost cylindrical in the oral half or two-thirds, and then usually contracts to an aboral opening about two-thirds the diameter of the oral opening.

Dimensions.—Length 108–120μ; diameter at mouth 33–43μ; diameter at foot 22–27μ.

Tintinnus apertus, Kofoid and Campbell.

Tintinnus inquilinus, Claparède and Lachmann, 1858, pp. 196–198, pl. viii, fig. 2.
Tintinnus apertus, Kofoid and Campbell, 1929, p. 331, fig. 648.

Occurrence.—Present at the weekly station from October to April. It is a neritic form, and appears when the other neritic species, *Tintinnopsis* spp. and *Codonellopsis ostenfeldii* are at their commonest.

Distribution.—The coast of Norway; the Mediterranean; the eastern Pacific.

Remarks.—This species is often seen attached to *Chaetoceros* spp. and is figured thus by Daday (1887), but in the Great Barrier Reef material it was always free. It is almost cylindrical in the upper three-quarters or four-fifths of the lorica, and then narrows to an opening about half the width of the mouth.

Dimensions.—Length 85–103μ; oral diameter 28–32μ; aboral diameter 15–17μ.

Daturella luanae, n. sp. Text-fig. 42.

Occurrence.—In Trinity Opening and at the weekly station in November, 1928.

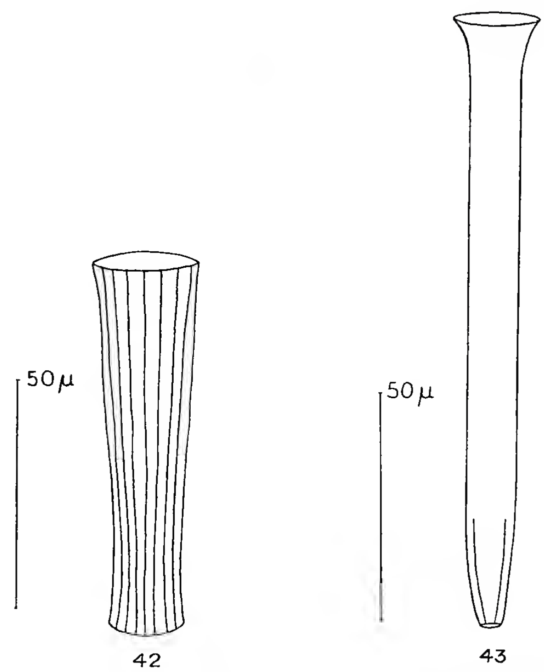
Distribution.—The Great Barrier Reef region.

Description.—The length is about three times the oral diameter. The lorica is thin and easily distorted, but in a normal specimen it is almost cylindrical in the upper half and then contracts slightly in the lower half. There is a slight oral flare. There are about 14 striae, running vertically from the oral to the aboral end.

It differs from all other species of the genus *Daturella* in its much smaller size.

The species is named after the "Luana", the yacht from which most of these hauls were made.

Dimensions.—Length 72–91μ; diameter at mouth 22–31μ (usually 26μ); aboral diameter 15–18μ.



Text-figs. 42, 43.—42. *Daturella luanae*. 43. *Salpingella subconica*.

Salpingella subconica, Kofoid and Campbell. Text-fig. 43.

Salpingella subconica, Kofoid and Campbell, 1929, p. 355, fig. 676.

Occurrence.—Rare. Occasional during the year, but not seen after April.

Distribution.—The eastern Pacific; in the Galapagos Eddy; the Mexican and Peruvian Currents; the Panamic area and the South Equatorial Drift.

Remarks.—Only a few specimens of this rare species were seen in the tow-nettings. It is probably slender enough to slip through the meshes of the net.

It has a flaring mouth and a long cylindrical body contracting aborally to a narrow opening. Six fins are visible on the contracted aboral end.

Dimensions.—Length 97–131μ; oral diameter 16–18μ; aboral opening about 4μ.

Table I.

	Weekly Station.																										Position.				
																											Trinity Opening.	Trinity Opening.	Cape Bedford.	Lizard Island.	Papuan Pass.
. . . . .	Aug.		Sept.		Oct.		Nov.		Dec.		Jan.			Feb.		Mar.			Apr.		May.		June.		July.		Aug.	Nov.	Feb.	Feb.	Feb.
number . .	3	6	10	13	15	18	23	25	32	35	37	38	39	41	42	47	48	51	53	55	57	58	61	63	64	67	8	26	43	44	49
intinnus nordqvisti .		+			+			c	+	+			+			+	c	c					+			+			+	+	
nopsis compressa .		+	+			+		+	+		+					c	+	c					+		+				+	f	
tensenii . .					+	+		c	+				+			+	+	c			+		+	+				+		+	
ndata . . .	+	+		+	+	+	+	+	+	+			f	+		+	+	c	+	+	+	+	+	+	+	+		+	+	+	+
ilis . . .	+	+	+		+	+		c	+		+	+	+	+		+	+	c	+	+	+	+	+	+	+			+	+	+	+
x . . .			+		+			c	+	+			+			+	+	c	+	+	+		+	+	+	+			+	+	
ndrica . . .		+	+		+	+		c				+	+		+	+	c	c					+	+				+		+	
ntinensis . .																+	+	+		+										+	
mella nivalis . .						+										+			+											+	
llopsis ostenfeldii .	c	c	+	+	+	+		c	+	+	c	c	+	+	+	+	+	c	c	f		+	+	c	f	+	+	+	+	+	+
ca . . .			+	+		+	+		+	+			+	+	+	+	+	+		f					f	+	+	+		+	+
icollis . . .	+	+	+		+	+	+		+	+	+	+	+	+	+	+	+	+		f	+			+	+	+	+	+		+	+
icaudata . .																														+	
ocylis scalaria .																															+
uroides . . .				+			+						+	+		+											+	+			+
a laciniosa . .																+															+
azorica . .			+				+		+											+						+		+		+	
ylis ralumensis .																+														+	
li . . .	+	+	+	+		+	+		+	+	+		+		+	+	+			+	f	+	+	+	+	+	+	f		+	f
tricta . . .	+																														
ua . . .																											+				
da . . .															+	+	+													+	+
lla . . .				+												+	+													+	+
xa . . .																+															+
la aperta . .													+			+														+	+
is corbula . .									+							+														+	
bdonella simplex .	+	+	+			+		+		+											c	f	+	f	c	f					
ui . . .																+			+						+					+	
ella spiralis .	+	+	+	+	+	c	+	+					+			+	+	+	+	f	f	+	+	+	+	f	+	+	+	+	
lti . . ,		+	+			+	+									+	+	+	+	f	f	+	c	+	c	f		+	+		+
tula . . .			+		+	+										+	+	+												+	+
m . . .	+	+		+		+	+	+		+			+	+	+	c	+	+	f	f	f	+	+		+	f		f	+	+	f
ellopsis intermedia	+		+	+		+										+	+						+				+			+	+
lla lanceolata .	+		+			+																					+				
ti . . .																+														+	+
hemispherica .						+										+														+	
da . . .																														+	
ella tenuis . .						+									+	+	+		+	+	+	+					+			+	f
silla . . .																+			+												
. . .						+																									
sta reticulata .																+			+	+	+						+				+
lla quadrilineata .	+	+	+		+	+				+		+	c	f	c	c	+		+	+			+		+	+		+	+	+	+
ti . . .	+		+		+	+		+		+	+		c	f	c	c	+	+		+		+			+		+			+	+
manni . .																+														+	
. . . .			+			+																				+					
piella steenstrupii			+			+	+									+				+								+			
escens . .																+															
llopsis acuta . .				+		+	+							+	+	f		+												+	+
la ganymedes .	+					+	+	+	+	+	+	+	+	+	+	c	+	+	+	+		+	+	+	+	+		+	+	+	+
s attenuatus . .			+			+		+	+	+		+	+	+	+	f	+								+	+			+	+	+
undae . .	+	+	+	+		+				+		+	f	+	+	f	+	+	f	+		+	+	+	+	f	+	+	+	+	+
ntus . . .	+	+	+		+	+		+	+		+			+		+												+		+	+
us . . .							+																								
s . . .						+	+		+			+		+	+	f	+	+		+									+	+	
luanae . .							+																					+			
la subconica .				+				+												+								+			

+ = Present, but not in large numbers. f = frequent. c = Common.

REFERENCES.

BORGERT, A. 1891. Über Dictyochiden, insbesondere über *Distephanus speculum*; sowie Studien an Phaeodarien. Z. wiss. Zool. LI, pp. 629–676, pl. xxxiii, text illust.

BRANDT, K. 1906. Die Tintinnodeen der Plankton-Expedition. Tafelerklärungen nebst kurzer Diagnose der neuen Arten. Ergebn. Plankton Exped. Humboldt Stiftung. III, L.a, pp. 1–33, pls. i–lxx.

—— 1907. Die Tintinnodeen der Plankton Expedition. Systematischer Teil. Ergebn. Plankton Exped. Humboldt Stiftung. III, L.a, pp. 1–488.

CLAPARÈDE, E., and LACHMANN, J. 1858–59 and 1861. Études sur les infusoires et les rhizopodes. Mem. Inst. Nat. Genevois, V, mem. 3, pp. 1–260, pls. i–xiii; VI, mem. 1, pp. 261–482, pls. xiv–xxiv; VII, mem. 1, pp. 1–291, pls. i–xiii.

CLEVE, P. T. 1899 (1900). Some Atlantic Tintinnodea. Öfvers. K. VetenskAkad. Förh. Stockholm, LVI, pp. 969–975, text illust.

—— 1900 (1901). Plankton from the Southern Atlantic and the Southern Indian Ocean. Öfvers. K. VetenskAkad. Förh. Stockholm, LVII, pp. 919–938, text illust.

DADAY, E. VON. 1886. Ein kleiner Beitrag zur Kenntnis der Infusorien Fauna des Golfes von Neapel. Mitt. Zool. Stat. Neapel, VI, pp. 481–498, pl. xxv.

—— 1887. Monographie der Familie des Tintinnodeen. Mitt. Zool. Stat. Neapel, VII, pp. 473–591, pls. xviii–xxi.

EHRENBERG, C. G. 1845. Neue Unters. ü. d. kleinste Leben als geol. Moment. Ber. Verhandl. K. Akad. wiss. Berlin, pp. 53–87.

ENTZ, GEZA. 1884. Über Infusorien des Golfes von Neapel. Mitt. Zool. Stat. Neapel, V, pp. 289–444, pls. xx–xxv.

—— 1885. Zur näheren Kenntnis der Tintinnoden. Mitt. Zool. Stat. Neapel, VI, pp. 185–216, pls. xiii, xiv.

GEMEINHARDT, K. 1930. Silicoflagellatae. Rabenhorst's Kryptogamen-Flora, X, Abt. 2, pp. 1–87, pl. i, text illust.

—— 1931. Silicoflagellaten. Deutsche süd-polar Exped. XX, pp. 217–258, pls. xlii, xliii, text illust.

HADA, Y. 1932. Report of the Biological Survey of Mutsu Bay. 24. The Pelagic Ciliata, Sub-order Tintinnoinea. Sci. Rep. Tohoku Imp. Univ. 4th Ser. (Biology), VII, pp. 553–573, text illust.

—— 1932*a*. The Tintinnoinea from the Sea of Okhotsk and its Neighbourhood. J. Fac. Sci. Hokkaido Imp. Univ. Ser. 6, II, pp. 37–59, text illust.

HAECKEL, E. 1862. Die Radiolarien (Rhizopoda Radiaria). Eine Monographie. Berlin; pp. xiv, 572; Atlas, 35 pls.

—— 1887. Report on the Radiolaria Collected by H.M.S. "Challenger". "Challenger" Exped. Report. Zoology 18. 3 vols.; illust.

HERTWIG, R. 1879. Organismus der Radiolarien. Denkschr. med.-nat. Ges. Jena, II, pp. 129–277, pls. vi–xv.

HOFKER, J. 1931. Studien über Tintinnoidea. Arch. Protistenk. Jena, LXXV, pp. 315–402, text illust.

IMHOF, O. E. 1886. Über microscopische pelagische Thiere aus den Lagunen von Venedig. Zool. Anz. IX, pp. 101–104.

JÖRGENSEN, E. 1924. Mediterranean Tintinnidae. Rep. Danish Oceanogr. Exped. 1908–1910, II, No. 8, J. 3, pp. 1–110, text illust.

KOFOID, C. A., and CAMPBELL, A. S. 1929. A Conspectus of the Marine and Fresh Water Ciliata belonging to the Suborder Tintinnoinea, with Descriptions of New Species, principally from the Agassiz Expedition to the Eastern Tropical Pacific, 1904–1905. Univ. Calif. Pub. Zool. XXXIV, pp. 1–403, text illust.

LAACKMANN, H. 1910. Die Tintinnodeen der Deutschen südpolar Expedition 1901–1903. Deutsche südpolar Exped. 1901–1903, XI, 3, pp. 341–496, pl. xxxiii–li.

LEMMERMANN, E. 1901. Silicoflagellatae. Ergebnisse einer Reise nach dem Pacific H. Schauinsland 1896–97. Ber. deuts. Bot. Ges. XIX, pp. 247–271, pls. x, xi.

MÜLLER, J. 1855. Über die in Hafen von Messina beobachteten Polycystinen. Mber. Akad. wiss. Berlin, 1855, pp. 671–676.

OSTENFELD, C. H., and SCHMIDT, J. 1902. Plankton fra det Røde Hav og Adenbugten. Vidensk. Medd. Naturh. Foren. Kjøbenhavn, 1901, pp. 141–182, text illust.

SCHMIDT, J. 1902. Some Tintinnoidea from the Gulf of Siam. Vidensk. Medd. Naturh. Foren. Kjøbenhavn, 1901, pp. 183–190, text illust.

SCHULZ, P. 1928. Beiträge zur Kenntnis fossiler und rezenter Silicoflagellaten. Bot. Arch. XXI, pp. 225–292, text illust.

INDEX

(The principal references are in heavy type.)